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Shimizu

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(54) **MOBILE TERMINAL, CONTROL METHOD, AND CONTROL PROGRAM**

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H04M 3/56 (2006.01)
H04M 1/725 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ..... ***H04W 76/005*** (2013.01); ***H04M 1/72519*** (2013.01); ***H04M 3/56*** (2013.01); ***H04M 3/566*** (2013.01); ***H04W 4/10*** (2013.01);***H04W 76/002*** (2013.01); *H04M 2201/14* (2013.01); *H04M 2201/38* (2013.01); *H04W 76/045* (2013.01)

(58) **Field of Classification Search**
CPC . H04W 76/00; H04W 76/002; H04W 76/005; H04W 76/045; H04W 4/10; H04M 3/56; H04M 3/566; H04M 2201/14; H04M 2201/38
USPC 455/518, 519
See application file for complete search history.

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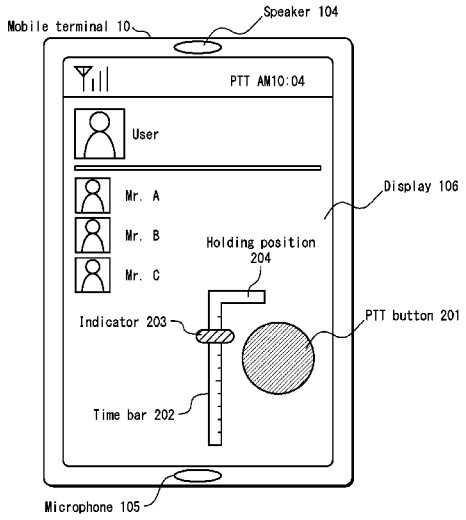
(57) **ABSTRACT**

A mobile terminal having a push-to-talk (PTT) function, including: a controller that, upon detection of an operation for terminating a predefined call mode, maintains the predefined call mode for a period of predefined time, and terminates the predefined call mode upon elapse of the period; a display that displays remaining time to termination of the predefined call mode; and a remaining time changer that, upon detection of an operation for changing the remaining time, changes the remaining time according to the operation for changing the remaining time.

14 Claims, 13 Drawing Sheets



(51) **Int. Cl.**
H04W 4/10 (2009.01)
H04W 76/04 (2009.01)

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FIG. 1

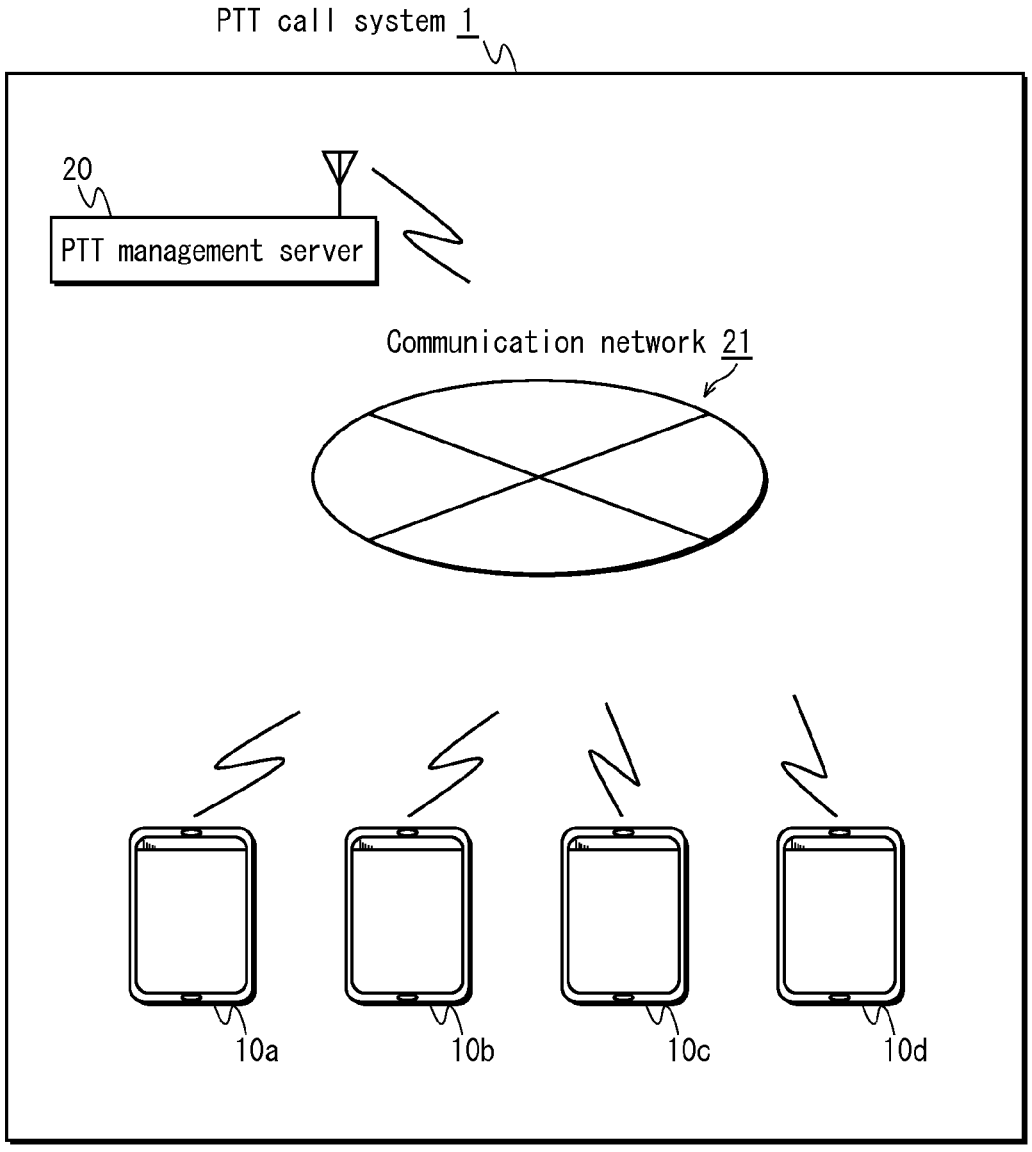

PTT call system 1
20
PTT management server
Communication network 21
10a
10b
10c
10d

FIG. 2

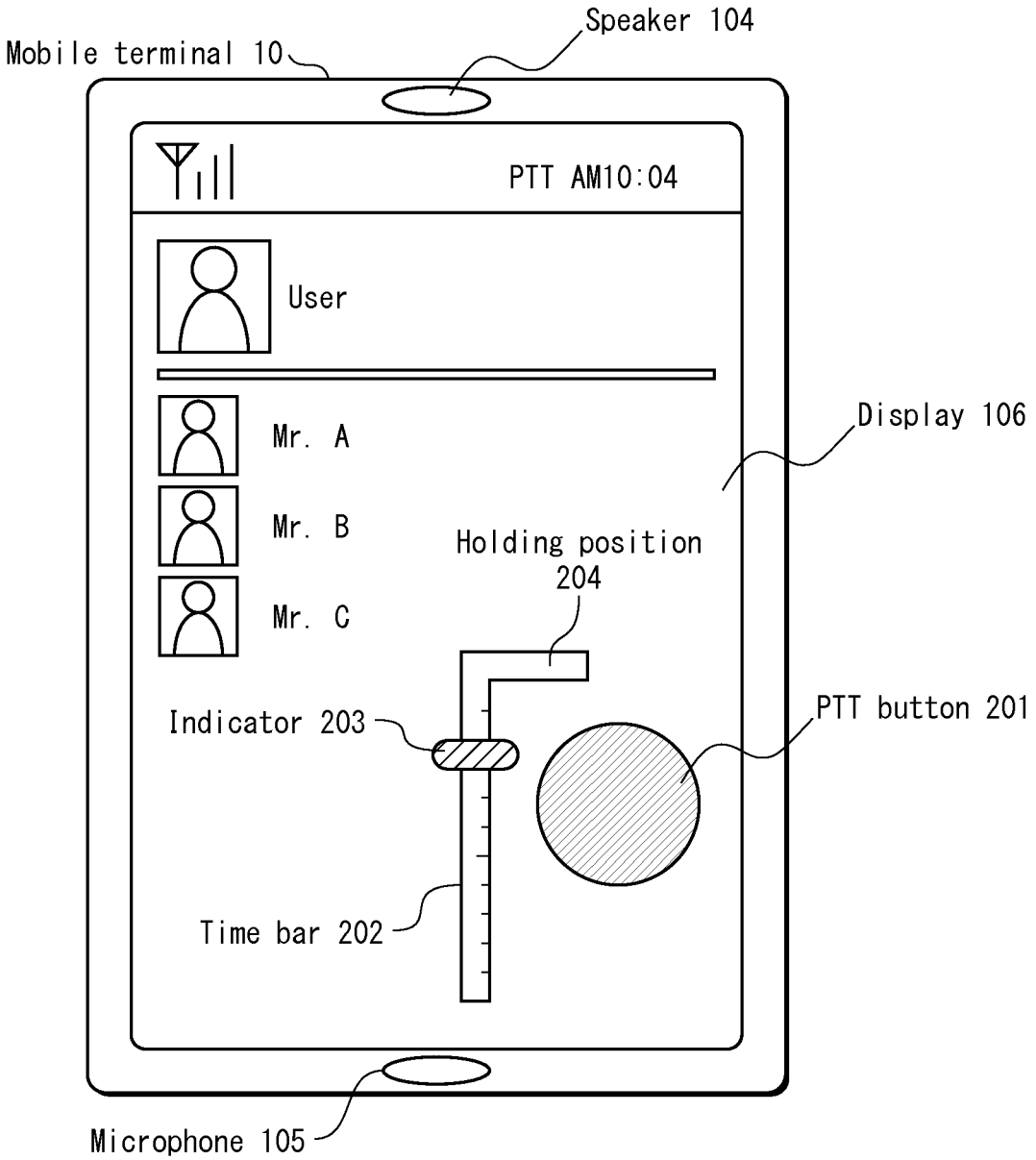

Mobile terminal 10
Speaker 104
PTT AM10:04
User
Mr. A
Mr. B
Mr. C
Display 106
Holding position 204
Indicator 203
PTT button 201
Time bar 202
Microphone 105

FIG. 3

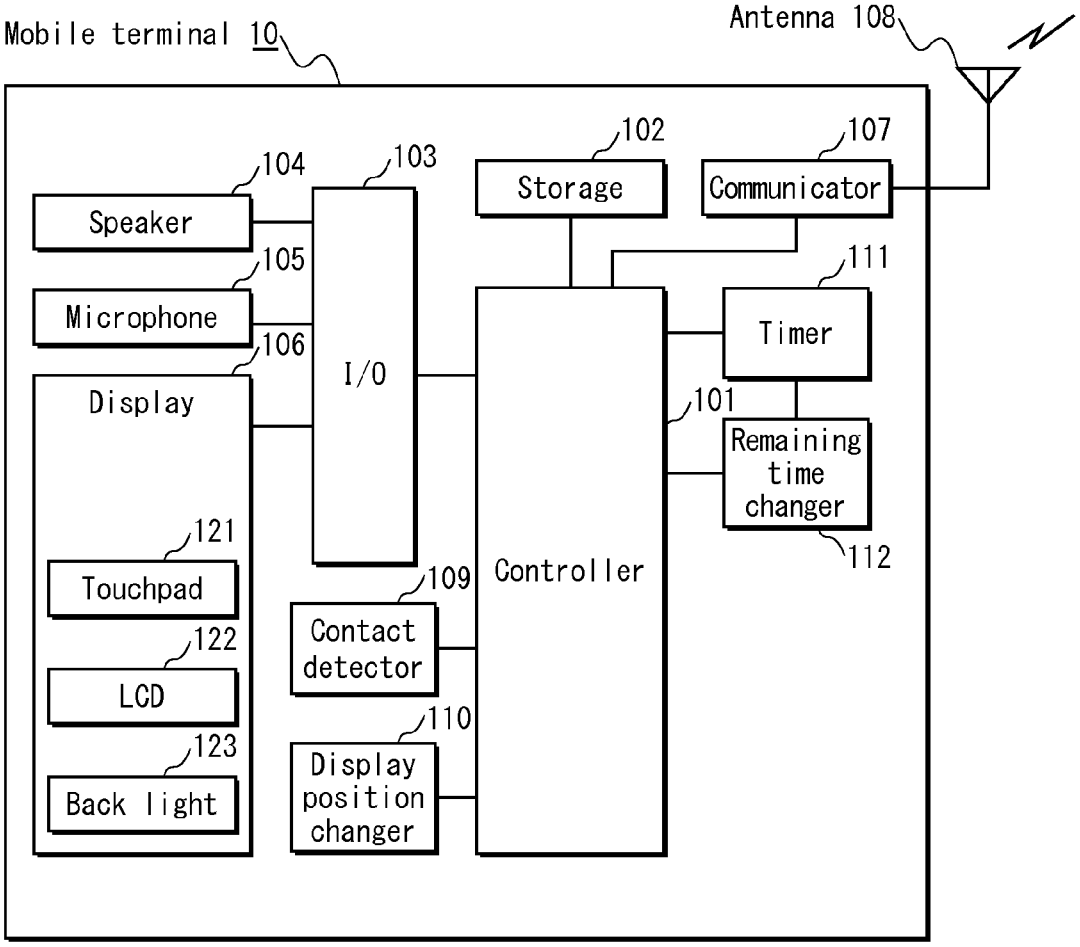

Mobile terminal 10
Antenna 108
102
107
104
103
Storage
Communicator
Speaker
105
111
Microphone
106
I/O
Timer
Display
101
Remaining time changer
112
121
Touchpad
109
Controller
Contact detector
122
LCD
110
123
Display position changer
Back light

FIG. 4

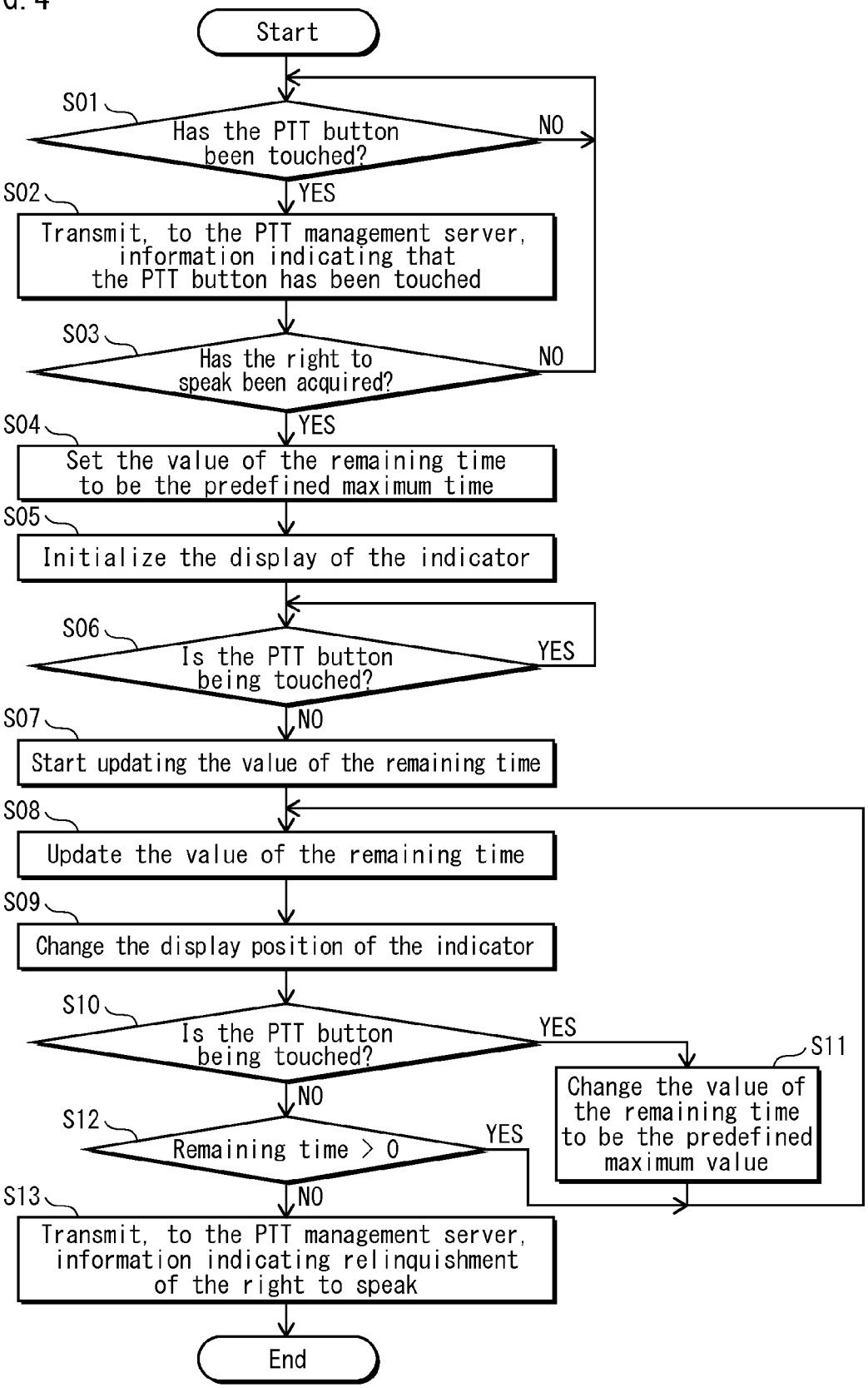

Start
S01
Has the PTT button been touched?
NO
YES
S02
Transmit, to the PTT management server, information indicating that the PTT button has been touched
S03
Has the right to speak been acquired?
NO
YES
S04
Set the value of the remaining time to be the predefined maximum time
S05
Initialize the display of the indicator
S06
Is the PTT button being touched?
YES
NO
S07
Start updating the value of the remaining time
S08
Update the value of the remaining time
S09
Change the display position of the indicator
S10
Is the PTT button being touched?
YES
S11
Change the value of the remaining time to be the predefined maximum value
NO
S12
Remaining time > 0
YES
NO
S13
Transmit, to the PTT management server, information indicating relinquishment of the right to speak
End

FIG. 5

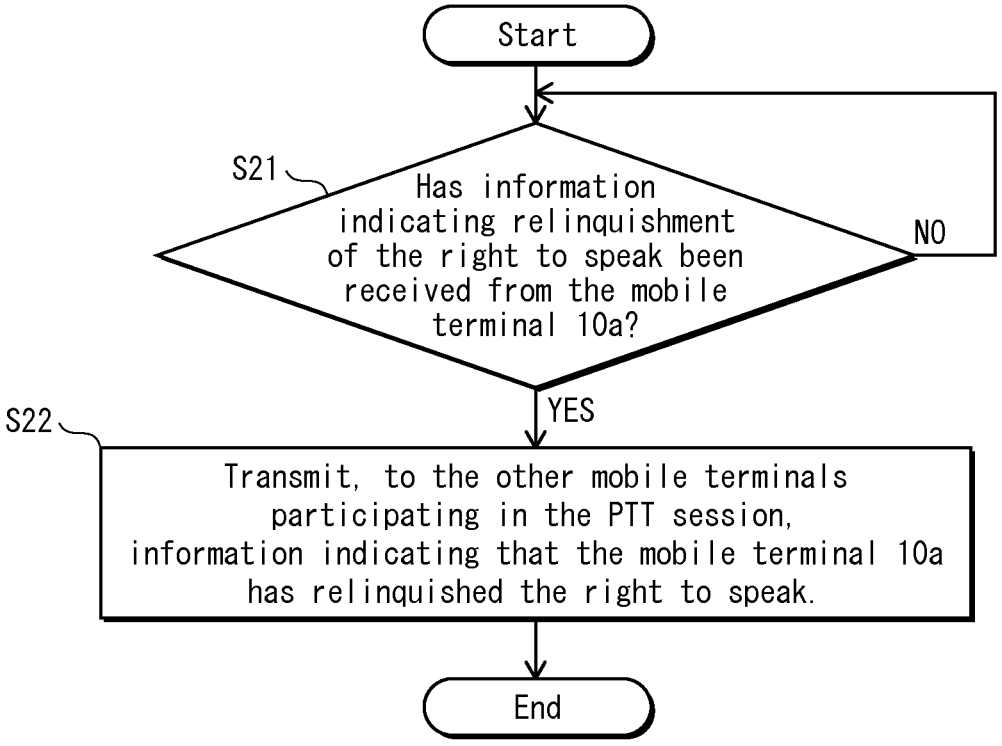

Start
S21
Has information indicating relinquishment of the right to speak been received from the mobile terminal 10a?
NO
YES
S22
Transmit, to the other mobile terminals participating in the PTT session, information indicating that the mobile terminal 10a has relinquished the right to speak.
End

FIG. 6

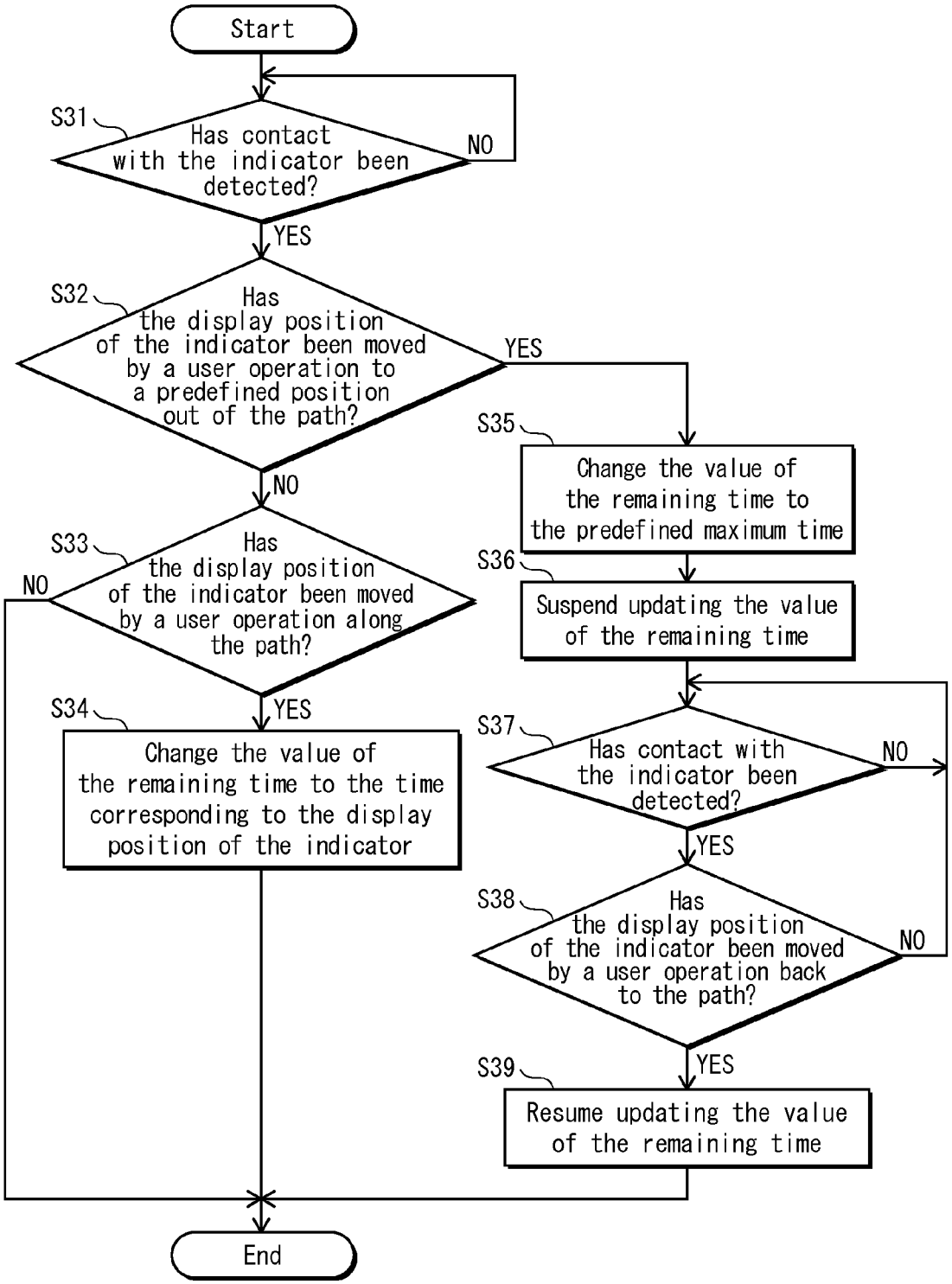

Start
S31
Has contact with the indicator been detected?
NO
YES
S32
Has the display position of the indicator been moved by a user operation to a predefined position out of the path?
YES
NO
S33
Has the display position of the indicator been moved by a user operation along the path?
NO
YES
S34
Change the value of the remaining time to the time corresponding to the display position of the indicator
S35
Change the value of the remaining time to the predefined maximum time
S36
Suspend updating the value of the remaining time
S37
Has contact with the indicator been detected?
NO
YES
S38
Has the display position of the indicator been moved by a user operation back to the path?
NO
YES
S39
Resume updating the value of the remaining time
End

FIG. 7

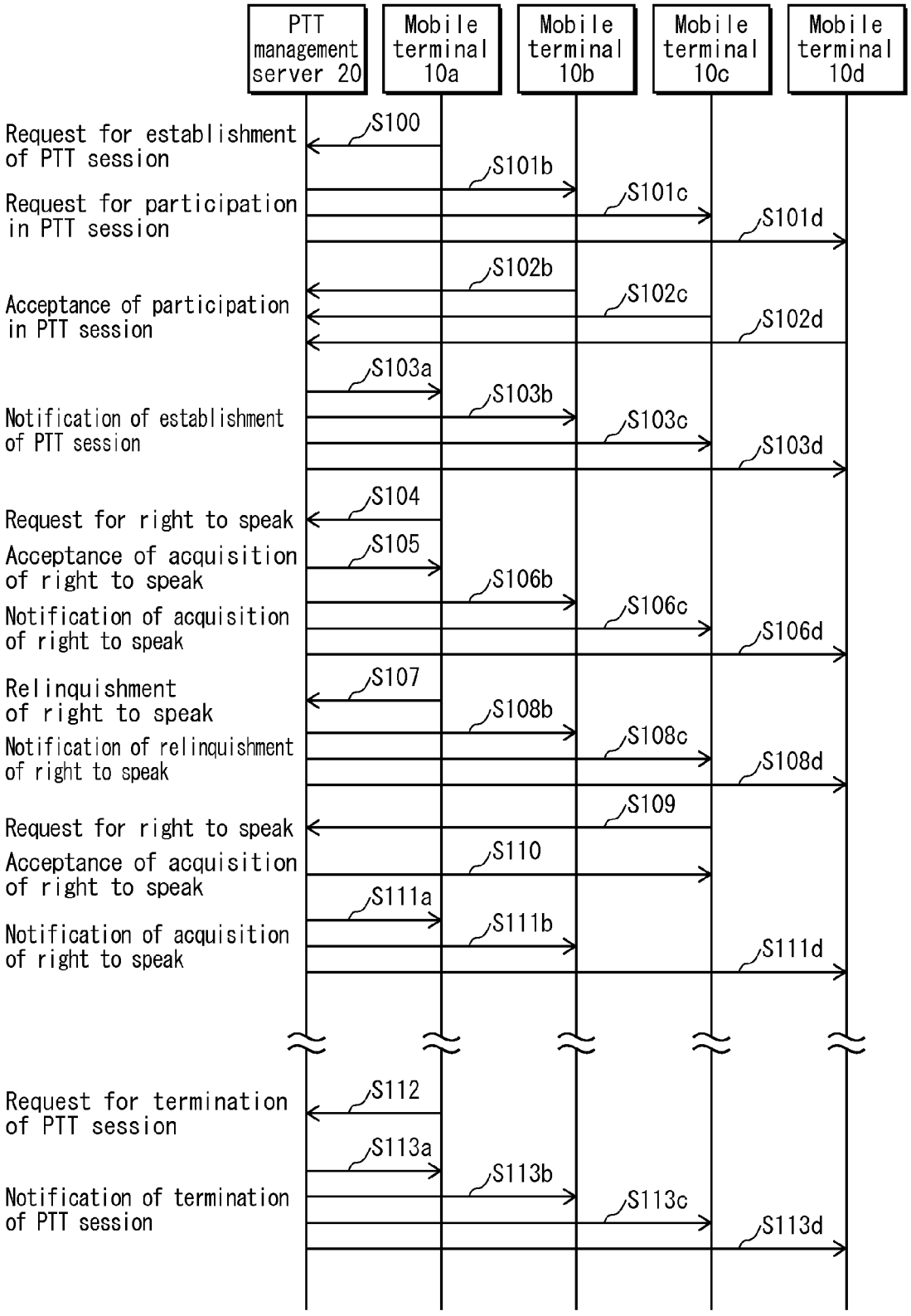

PTT management server 20
Mobile terminal 10a
Mobile terminal 10b
Mobile terminal 10c
Mobile terminal 10d
Request for establishment of PTT session
S100
S101b
S101c
S101d
Request for participation in PTT session
S102b
S102c
S102d
Acceptance of participation in PTT session
S103a
S103b
S103c
S103d
Notification of establishment of PTT session
S104
Request for right to speak
S105
S106b
S106c
S106d
Acceptance of acquisition of right to speak
Notification of acquisition of right to speak
S107
S108b
S108c
S108d
Relinquishment of right to speak
Notification of relinquishment of right to speak
S109
Request for right to speak
S110
Acceptance of acquisition of right to speak
S111a
S111b
S111d
Notification of acquisition of right to speak
S112
Request for termination of PTT session
S113a
S113b
S113c
S113d
Notification of termination of PTT session

FIG. 8A

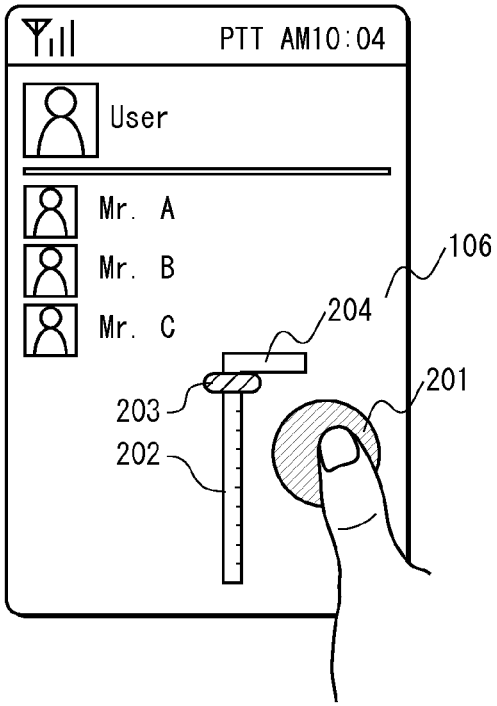


FIG. 8C

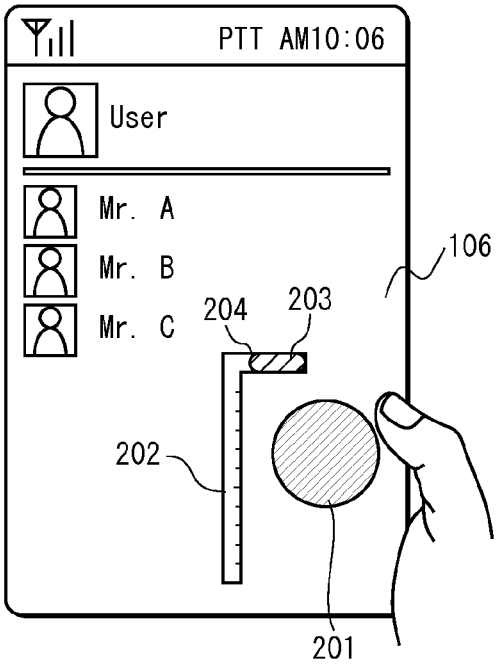


FIG. 8B

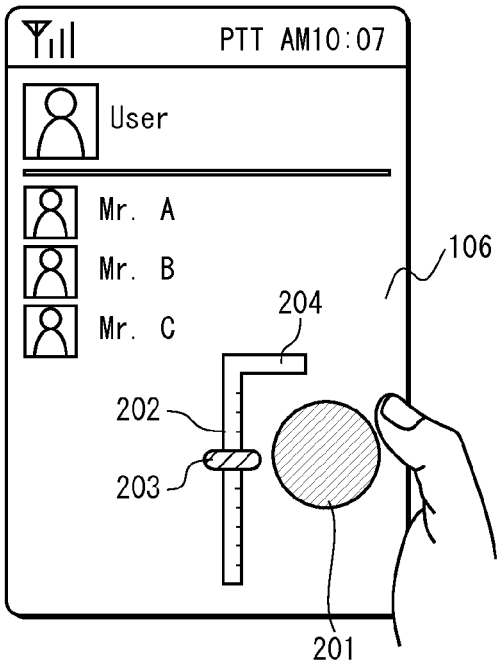


FIG. 9

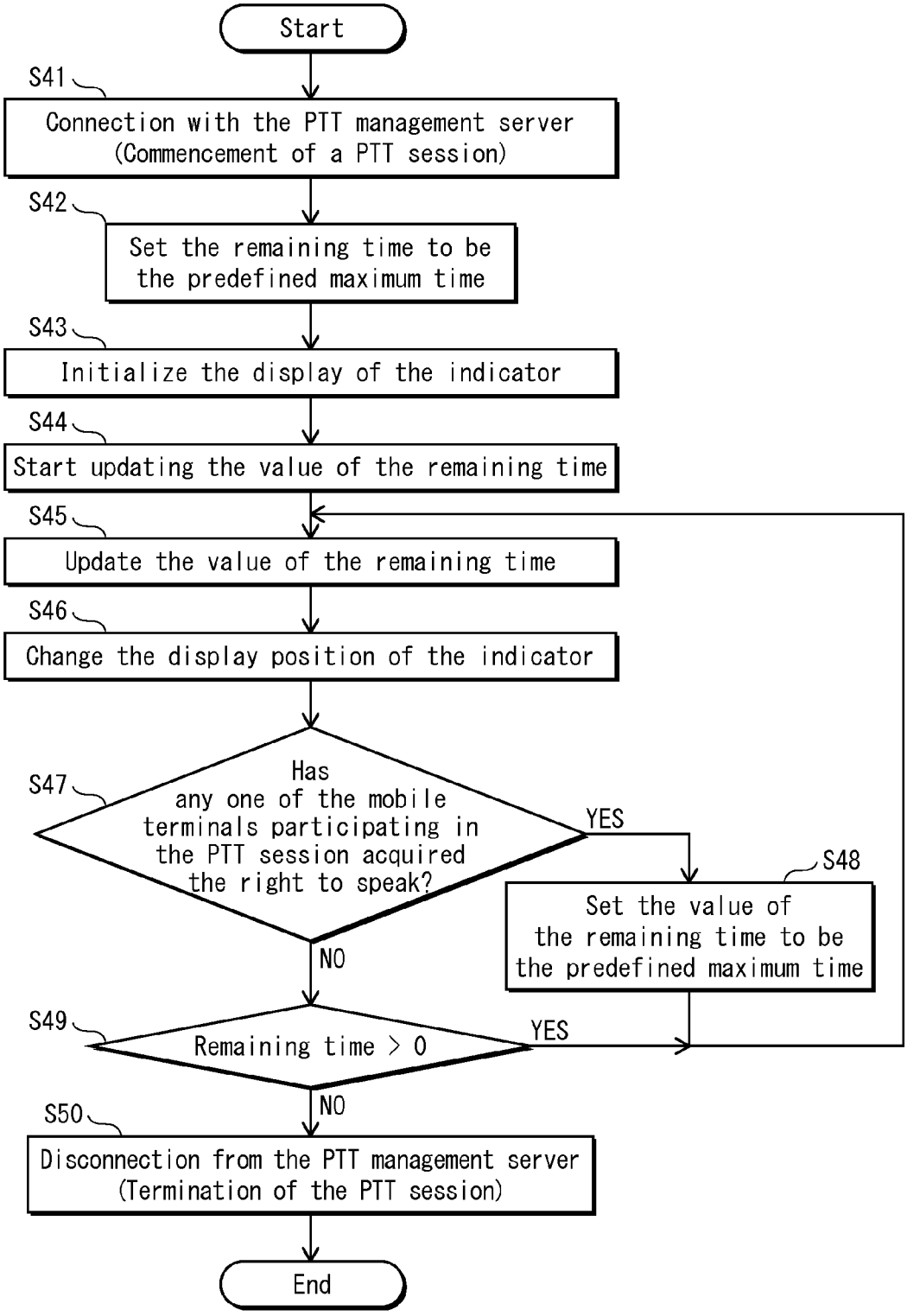

Start
S41
Connection with the PTT management server (Commencement of a PTT session)
S42
Set the remaining time to be the predefined maximum time
S43
Initialize the display of the indicator
S44
Start updating the value of the remaining time
S45
Update the value of the remaining time
S46
Change the display position of the indicator
S47
Has any one of the mobile terminals participating in the PTT session acquired the right to speak?
YES
S48
Set the value of the remaining time to be the predefined maximum time
NO
S49
Remaining time > 0
YES
NO
S50
Disconnection from the PTT management server (Termination of the PTT session)
End

FIG. 10

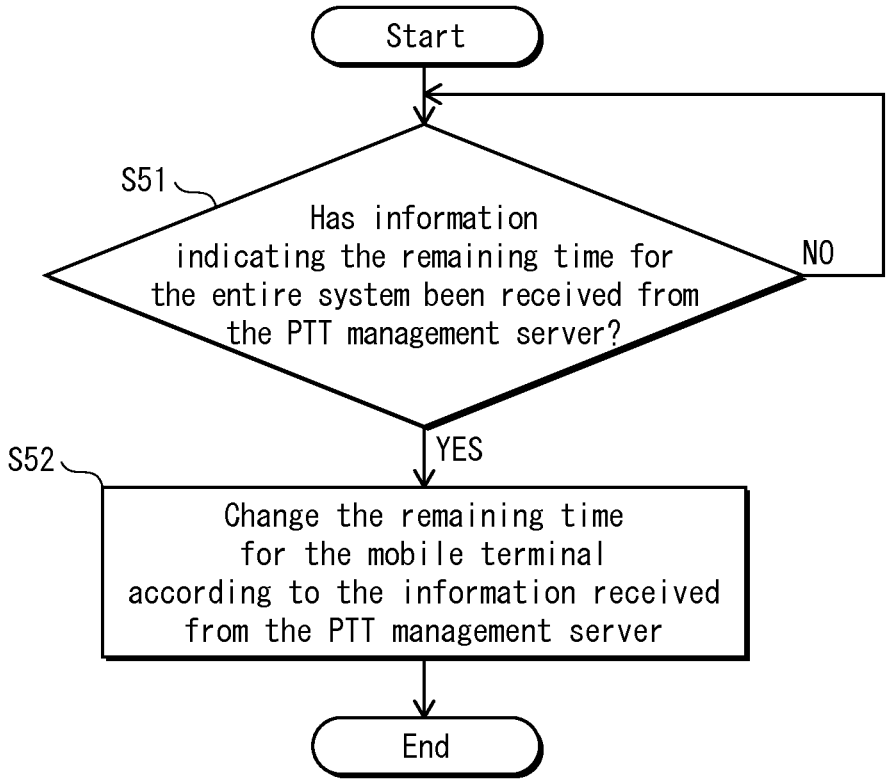

Start
S51
Has information indicating the remaining time for the entire system been received from the PTT management server?
NO
YES
S52
Change the remaining time for the mobile terminal according to the information received from the PTT management server
End

FIG. 11

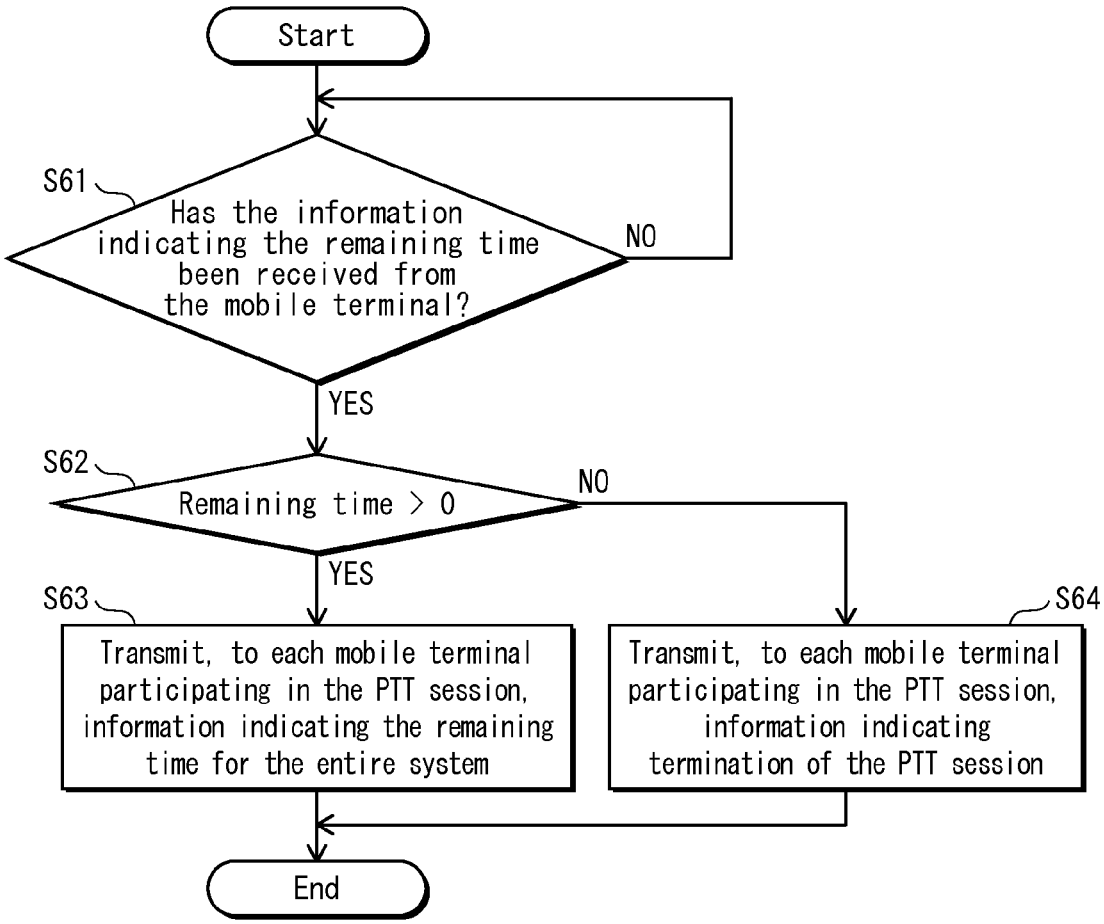

Start
S61
Has the information indicating the remaining time been received from the mobile terminal?
NO
YES
S62
Remaining time > 0
NO
YES
S63
Transmit, to each mobile terminal participating in the PTT session, information indicating the remaining time for the entire system
S64
Transmit, to each mobile terminal participating in the PTT session, information indicating termination of the PTT session
End

FIG. 12A

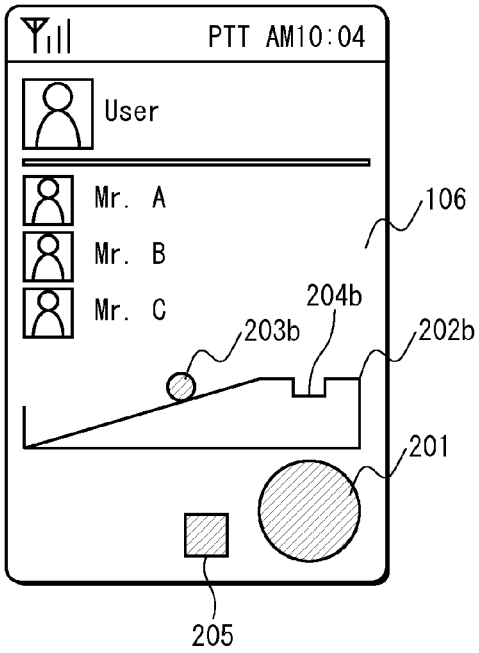


FIG. 12C

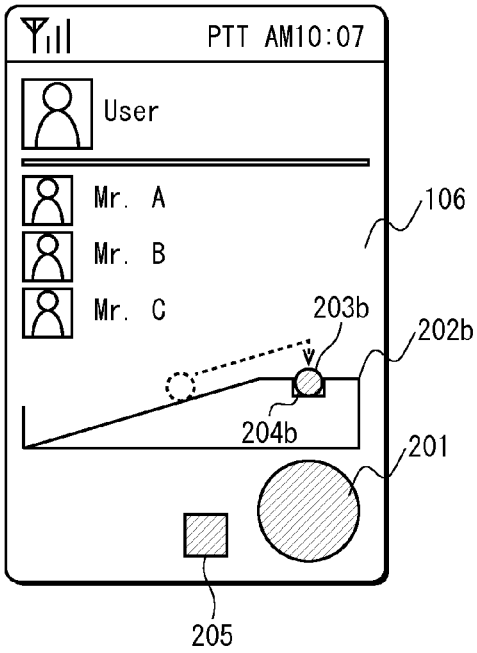


FIG. 12B

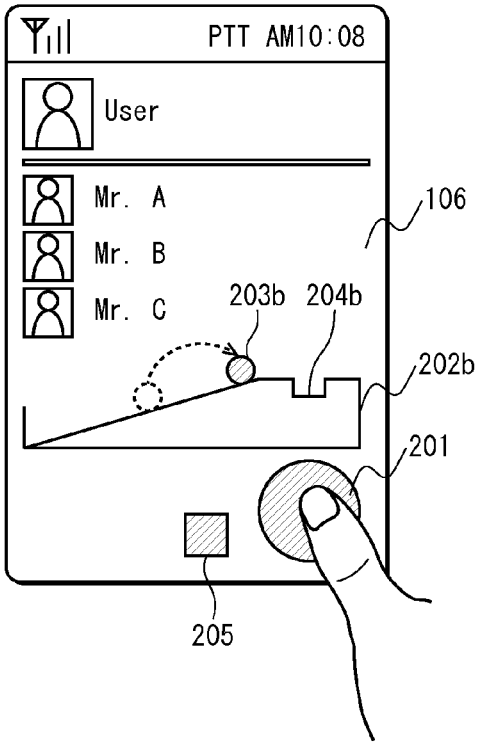
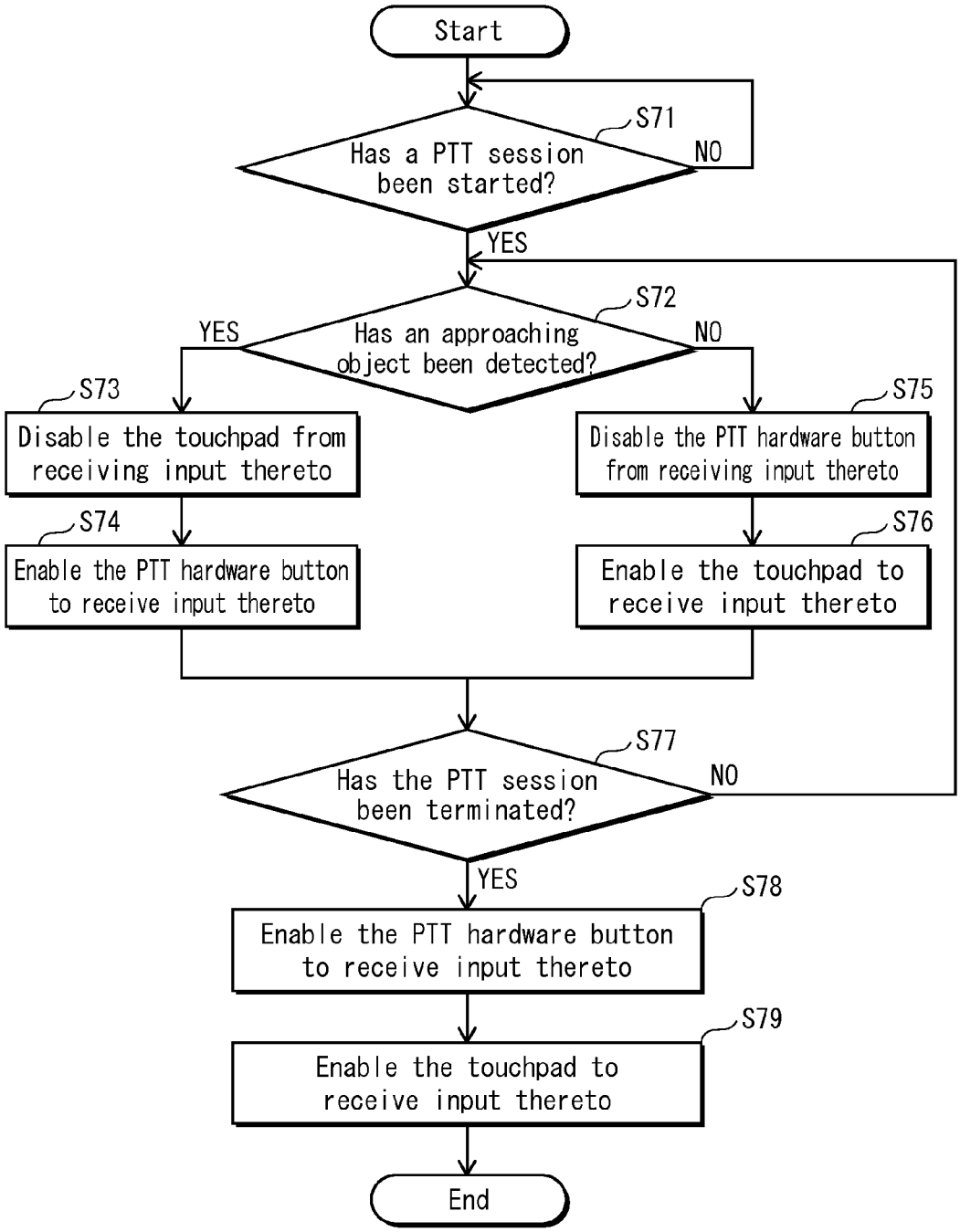


FIG. 13


Start
S71
Has a PTT session been started?
NO
YES
S72
Has an approaching object been detected?
YES
NO
S73
Disable the touchpad from receiving input thereto
S74
Enable the PTT hardware button to receive input thereto
S75
Disable the PTT hardware button from receiving input thereto
S76
Enable the touchpad to receive input thereto
S77
Has the PTT session been terminated?
NO
YES
S78
Enable the PTT hardware button to receive input thereto
S79
Enable the touchpad to receive input thereto
End

MOBILE TERMINAL, CONTROL METHOD, AND CONTROL PROGRAM

TECHNICAL FIELD

The present invention relates to mobile terminals having a push-to-talk (PTT) function, and in particular to improvements in an user interface.

BACKGROUND ART

In recent years, PTT services are becoming popular, which realize one-to-many calls among mobile terminals having a PTT function. PTT services allow for a call among multiple people, however, do not allow two or more people to speak at the same time. Therefore, a user of a mobile terminal needs to wait for another user to finish speaking, and then acquire the right to speak before starting speaking.

A mobile telephone disclosed in Patent Literature 1 has a PTT function, and has a button used for making a PTT call (hereinafter "PTT button"). Specifically, when the PTT button is pressed, the mobile telephone acquires the right to speak from a PTT management server. The mobile telephone is maintained in voice transmission mode as long as the PTT button is being pressed, during which a voice can be transmitted.

CITATION LIST

Patent Literature

[Patent Literature 1] Japanese Patent Application Publication No. 2005-318575

SUMMARY OF INVENTION

Technical Problem

However, with the mobile telephone disclosed in Patent Literature 1, the user loses the right to speak when releasing the PTT button. Therefore, if the user mistakenly releases the PTT button during a PTT call, the call is disconnected unintentionally. If all the users are accustomed to PTT services, it is unlikely that disconnection as described above occurs. However, if any of the users are not accustomed, unintended disconnection might occur.

The present invention is made in view of the problem described above, and aims to provide a mobile terminal, a control method, and a control program, that are capable of preventing unintended disconnection of a call when the PTT button is released.

Solution to Problem

To solve the problem, one aspect of the present invention provides a mobile terminal having a push-to-talk (PTT) function, comprising: a controller that, upon detection of an operation for terminating a predefined call mode, maintains the predefined call mode for a period of predefined time, and terminates the predefined call mode upon elapse of the period; a display that displays remaining time to termination of the predefined call mode; and a remaining time changer that, upon detection of an operation for changing the remaining time, changes the remaining time according to the operation for changing the remaining time.

Another aspect of the present invention is a method for controlling a mobile terminal having a push-to-talk (PTT) function, comprising: maintaining, upon detection of an operation for terminating a predefined call mode, the predefined call mode for a period of predefined time, and terminating the predefined call mode upon elapse of the period; displaying remaining time to termination of the predefined call mode; and changing, upon detection of an operation for changing the remaining time, the remaining time according to the operation for changing the remaining time.

Another aspect of the present invention is a control program for controlling a mobile terminal having a push-to-talk (PTT) function, the control program causing the mobile terminal to perform the steps of: maintaining, upon detection of an operation for terminating a predefined call mode, the predefined call mode for a period of predefined time, and terminating the predefined call mode upon elapse of the period; displaying remaining time to termination of the predefined call mode; and changing, upon detection of an operation for changing the remaining time, the remaining time according to the operation for changing the remaining time.

Effects of Invention

The present invention provides a mobile terminal, a control method, and a control program, that are capable of preventing unintended disconnection of a PTT call.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a schematic diagram illustrating a configuration of a PTT call system **1**.

FIG. **2** is schematic diagram illustrating an exterior appearance of a mobile terminal **10**.

FIG. **3** is a functional block diagram illustrating primary components of the mobile terminal **10**.

FIG. **4** is a flowchart illustrating processing performed when a PTT button of the mobile terminal **10** pertaining to Embodiment 1 is operated.

FIG. **5** is a flowchart illustrating processing performed by a PTT management server **20** when receiving information indicating relinquishment of the right to speak.

FIG. **6** is a flowchart illustrating processing performed when an indicator of the mobile terminal **10** pertaining to Embodiment 1 is operated.

FIG. **7** illustrates an example processing sequence performed within a PTT call system **1** during a call.

FIG. **8**A illustrates example display when the PTT button is touched, FIG. **8**B illustrates example display when a finger is released from the PTT button, and FIG. **8**C illustrates an example display position of an indicator used for suspending a countdown of the remaining time.

FIG. **9** is a flowchart illustrating processing for controlling the remaining time to the termination of a PTT session of the mobile terminal **10** pertaining to Embodiment 2.

FIG. **10** is a flowchart illustrating processing performed by the mobile terminal **10** pertaining to a modification when receiving information indicating the remaining time from the PTT management server **20**.

FIG. **11** is a flowchart illustrating processing performed by the PTT management server **20** when receiving information indicating the remaining time from the mobile terminal **10**.

FIG. **12**A illustrates a modification of display when the PTT button is touched, FIG. **12**B illustrates a modification of display when the finger is released from the PTT button, and FIG. **12**C illustrates a modification of the display position of the indicator used for halting the countdown of the remaining time.

FIG. **13** is a flowchart illustrating processing of switching between an operation with a PTT button **201** and an operation with a hardware button for PTT calls.

DESCRIPTION OF EMBODIMENTS

The following describes an embodiment of a mobile terminal pertaining to the present invention.

Embodiment 1

1-1. Overview

FIG. **1** is a schematic diagram illustrating a configuration of a PTT call system **1** using the mobile terminal **10** pertaining to the present embodiment.

The following briefly describes the PTT call system **1** with reference to FIG. **1**.

The PTT call system **1** includes mobile terminals **10***a* through **10***d*, a PTT management server **20**, and a communication network **21**.

Each of the mobile terminals **10***a* through **10***d* has a PTT function which realizes a one-to-many call.

The PTT management server **20** has the function of managing participation into and withdrawal from a PTT session, the function of managing the right to speak, and the function of transmitting a speaker's voice to the mobile terminals participating in the PTT session.

The mobile terminals **10***a* through **10***d* connects to the PTT management server **20** via the communication network **21**. The PTT management server **20** manages the mobile terminals **10***a* through **10***d* as a call group, and establishes a PTT session with the mobile terminals **10***a* through **10***d*. When a PTT session is established, only the mobile terminal that has acquired the right to speak from the PTT management server **20** is allowed to transmit a voice. The voice is transmitted to all the mobile terminals in the call group via the PTT management server **20**. Note that the right to speak is authority to transmit a voice, which is managed by the PTT management server **20** and is given to a mobile terminal in response to a request from the mobile terminal. Only the mobile terminal that has acquired the right to speak is allowed to transmit a voice. While the right to speak is being held by one mobile terminal, the PTT management server **20** cannot give the right to speak to another mobile terminal in the same call group. In other words, when one mobile terminal holds the right to speak, the other mobile terminals in the same group cannot acquire the right to speak.

FIG. **2** is a schematic diagram illustrating the exterior appearance of the mobile terminal **10**.

The mobile terminal **10** operates according to an instruction from a touch panel thereof.

To acquire the right to speak, the user touches and keeps holding a PTT button **201** displayed in a display **106**. When finishing speaking, the user stops holding the PTT button **201** and relinquishes the right to speak. Generally, a touch panel does not have convexities or concavities, and the user can not feel the PTT button **201** when touching the PTT button **201**. Hence, it is not easy for the user to keep holding the PTT button **201** displayed on the display **106**. Therefore, the user might unintentionally release the PTT button **201** even during speaking. Considering this, the mobile terminal **10** does not transmit a notification of relinquishment of the right to speak to the PTT management server **20** even when the user unintentionally releases the PTT button **201**, and remains in the same state as when the PTT button **201** is being touched, until a predefined period elapses. Thus, the mobile terminal **10** prevents unintentional relinquishment of the right to speak when the user mistakenly stops holding the PTT button **201**.

In such cases, however, after the user stops holding the PTT button **201**, it is difficult for the user to know the length of time left until the relinquishment of the right to speak. Considering this, the mobile terminal **10** displays a time bar **202** and an indicator **203** on the display **106** as illustrated in FIG. **2**, and allows the user to know the remaining time by continuously changing the display position of the indicator **203**. Note that the expression "remaining time" used in the present embodiment is the time from when the user stops holding the PTT button **201** to when the right to speak is relinquished. Even after the user stops holding the PTT button **201**, the mobile terminal **10** remains in the same state as when the user keeps holding the PTT button **201**, until the remaining time becomes zero, i.e., until the indicator **203**, which moves over time, reaches the bottom end of the time bar **202**. In other words, the user can maintain the right to speak for a predefined period without keeping holding the PTT button **201**. Thus, the stated configuration reduces the user's burden for pressing the button, and reduces the load onto the touch panel as well. Furthermore, the mobile terminal **10** extends the remaining time when the PTT button **201** is touched again before the remaining time becomes zero. Therefore, when the remaining time is running out, the user can extend the remaining time by touching the PTT button **201** again. In other words, the user can maintain the right to speak until the end of the PTT call, by touching the PTT button **201** as necessary instead of keeping holding the PTT button **201** throughout the call.

The following describes in detail the mobile terminal **10** used in the PTT call system **1**.

1-2. Configuration

FIG. **3** is a functional block diagram illustrating primary components of the mobile terminal **10**.

As illustrated in the figure, the mobile terminal **10** includes a controller **101**, a storage **102**, an I/O **103**, a speaker **104**, a microphone **105**, a display **106**, a communicator **107**, an antenna **108**, a contact detector **109**, a display position changer **110**, a timer **111**, and a remaining time changer **112**.

The controller **101** has The function of controlling the mobile terminal **10**, which is common to general mobile terminals, the function of controlling display on the display **106**, the function of controlling input and output of the speaker **104** and the microphone **105** via the I/O **103**, and the function of controlling PTT sessions.

The controller **101** includes a central processing unit (CPU), read only memory (ROM), and non-volatile memory (e.g. flash memory). The functions of the controller **101** are realized by the CPU executing control programs stored in the ROM.

The storage **102** is made up from a storage medium such as non-volatile memory, and stores the value of the maximum time (e.g. 30 seconds) for which the user is allowed to speak after acquiring the right to speak once.

The I/O **103** is an input/output interface. The speaker **104**, the microphone **105** and the display **106** exchange data with the controller **101** via the I/O **103**.

The display **106** includes a touchpad **121**, a liquid crystal display (LCD) **122**, and a back light **123**.

The touchpad **121** is provided on the surface of the LCD **122**. The touchpad **121** (e.g. a capacitance-type touch sensor) is an input device that receives touch operations on a display object displayed on the LCD **122**. A controller IC (not illustrated) included in the touchpad **121** detects whether the

user's finger, for example, has contacted the touchpad **121**, every predefined unit of time (e.g. every 25 msec.). When detecting contact, the controller IC sends the coordinate values of the contact point to the controller **101**.

Touch operations include a tap, a double tap, a long tap, a flick, a slide, a drag, and so on.

The following specifically describes these touch operations.

A tap is an operation of touching the touchpad **121** with a finger and releasing the finger from the touchpad **121** within a short period.

A double tap is an operation of repeating a tap on the touchpad **121** twice within a short period.

A long tap is an operation of holding a finger on the touchpad **121** for a predefined period and then releasing the finger from the touchpad **121**.

A flick is an operation of quickly brushing the touchpad **121** with a finger towards a given direction. More specifically, a flick is an operation of touching the touchpad **121** with a finger and brushing the touchpad with the finger towards a given direction at a given speed.

A slide is an operation of touching the touchpad **121** with a finger and moving the finger towards a given direction while keeping the finger in contact with the touchpad **121**. A slide may also refer to a drag, which is an operation of touching a display object (e.g. an icon used for starting up an application, a shortcut icon, a file, a folder, etc.) displayed on the LCD **122** with a finger and moving the object.

The LCD **122** has a function of displaying a display object such as a text and an image at a specified position according to an instruction from the controller **101**.

The back light **123** is, for example, a device such as a light emitting diode (LED), and serves as a light source for illumination, emitting light from the rear side of the LCD **122**.

The speaker **104** outputs, for example, a voice during a voice call and warning sound during operation of the mobile terminal **10**.

The microphone **105** receives input of a voice. For example, the microphone **105** receives input of the user's voice during a call.

The communicator **107** is a wireless communication circuit that performs wireless communication with a base station via the antenna **108**. The communicator **107** performs wireless communication with the external PTT management server **20** via a base station, and wireless communication common to mobile telephones.

The contact detector **109** has the function of detecting a tap operation onto the PTT button **201** and determining whether a drag operation on the indicator **203** has been performed or not, with reference to coordinate values received via the controller **101**.

The display position changer **110** has the function of calculating the display position of the indicator **203** according to the value of the remaining time. The display position changer **110** calculates the display position of the indicator **203** based on the value of the remaining time continuously updated by the timer **111** and on the result of the detection by the contact detector **109** received from the controller **101**, and sends to the controller **101** the coordinate values of the display position of the indicator **203** to be displayed on the display **106**.

The timer **111** has the function of measuring the elapsed time from a given operation (e.g. an operation of touching then releasing the PTT button **201**) performed by the user, continuously updating the value of the remaining time according to the elapsed time, and sending the updated value of the remaining time to the controller **101** and the remaining time changer **112**. Note that the expression "the value of the remaining time" is the value of a variable that represents time and is used in the processing within the mobile terminal **10**. In the following explanation, the expression "the value of the remaining time" is used in this sense. In the following explanation, the expression "countdown" means continuously updating the remaining time to decrement the remaining time.

The remaining time changer **112** has the function of changing the value of the remaining time upon receiving a tap operation onto the PTT button **201**, a drag operation on the indicator **203**, or information related to the remaining time from the external PTT management server **20**, and sending the value of the remaining time so changed to the controller **101** and the timer **111**.

1-3. Operations

The following describes operations of the mobile terminal **10** having the above-described configuration, with reference to FIG. **4**.

Suppose that the mobile terminal **10** is connected to the PTT management server **20**, and a PTT session has been established.

FIG. **4** is a flowchart illustrating processing performed by the mobile terminal **10** when the user operates the PTT button **201**.

As illustrated in FIG. **2**, the PTT button **201**, the time bar **202** and the indicator **203** are displayed on the display **106** of the mobile terminal **10**. The PTT button **201** receives a tap operation, and the indicator **203** receives a drag operation.

First, the contact detector **109** determines whether the PTT button **201** displayed on the display **106** has been touched or not (Step S**01**). Specifically, the contact detector **109** determines that the PTT button **201** has been touched when the coordinate values of the contact point on the touchpad **121**, received from the controller **101**, are within the display range of the PTT button **201**.

When it is determined that the PTT button **201** has been touched (Step S**01**: YES), the communicator **107** transmits information indicating that the PTT button **201** has been touched, to the PTT management server **20** via the antenna **108** (Step S**02**).

When receiving from the mobile terminal **10** the information indicating that the PTT button **201** has been touched, the PTT management server **20** transmits information indicating acceptance of the request for the right to speak to the mobile terminal **10** if the right to speak is not being held by any other mobile terminals participating in the PTT session. If any one of the mobile terminals is holding the right to speak, the PTT management server **20** transmits information indicating denial of the request for the right to speak to the mobile terminal **10**.

The communicator **107** transmits to the controller **101** the information received from the PTT management server **20** via the antenna **108**, which indicates acceptance or denial of the request for the right to speak. Based on the information, the controller **101** determines whether the mobile terminal **10** has successfully acquired the right to speak or not (Step S**03**). Specifically, when receiving the information indicating acceptance, the controller **101** determines that the mobile terminal **10** has successfully acquired the right to speak, and when receiving the information indicating denial, the controller **101** determines that the mobile terminal **10** has failed to acquire the right to speak.

When the mobile terminal **10** fails to acquire the right to speak (Step S**03**: NO), the processing returns to Step S**01** and the mobile terminal **10** is brought into standby mode.

On the other hand, when the mobile terminal **10** acquires the right to speak (Step S**03**: YES), the controller **101** sets the value of the remaining time to the relinquishment of the right to speak to be the maximum time (e.g. 30 seconds) stored in the storage **102** in advance, and sends the value of the remaining time to the timer **111** (Step S**04**).

The display position changer **110** calculates the coordinate values of the display position of the indicator **203** when the value of the remaining time indicates the maximum time, and sends the coordinate values to the controller **101**. The controller **101** instructs the display **106** to display the indicator **203** at the position specified by the coordinate values, and the display **106** displays the indicator **203** at the position indicated by the coordinate values (Step S**05**).

Next, the contact detector **109** determines whether the PTT button **201** is being touched or not (Step S**06**). Specifically, while the coordinate values of the contact point on the touchpad **121** detected every unit time (e.g. every 25 msec.) remain within the display range of the PTT button **201**, the contact detector **109** determines that the PTT button **201** is being touched. When determining that the coordinate values are not within the display range of the PTT button **201**, the contact detector **109** determines that the PTT button **201** is no longer being touched. When it is determined that the PTT button **201** is being touched (Step S**06**: YES), the right to speak is maintained, and the value of the remaining time is not updated.

When it is determined that the PTT button **201** is no longer being touched (Step S**06**: NO), the timer **111** starts updating the value of the remaining time (Step S**07**), and continuously updates the value of the remaining time until relinquishment of the right to speak according to the elapsed time from the point when it is detected that the PTT button **201** is no longer being touched (Step S**08**).

The display position changer **110** continuously receives the value of the remaining time from the timer **111**, and calculates the coordinate values used for chanting the display position of the indicator **203** on the display **106** according to the remaining time (Step S**09**). Specifically, the top end of the time bar is the display position of the indicator **203** when the value of the remaining time is the predefined maximum time, and the bottom end of the time bar **202** is the display position of the indicator **203** when the remaining time is zero. When L**0** denotes the length of the time bar **202** between the top end and the bottom end, T**0** denotes the maximum value of the remaining time, and T denotes the actual remaining time, the display position changer **110** calculates length L corresponding to the actual remaining time T by $L=L0\times T/T0$ and then calculates the coordinate values of the point having a distance L along the time bar **202** from the bottom end of the time bar **202**. The display position changer **110** sends the coordinate values to the controller **101**. The controller **101** instructs the display **106** to display the indicator **203** at the position specified by the coordinate values, and the display **106** displays the indicator **203** at the position indicated by the coordinate values.

When the contact detector **109** detects a touch operation onto the PTT button **201** while the value of the remaining time is being continuously updated over time (Step S**10**: YES), the remaining time changer **112** changes the value of the remaining time to the maximum time (e.g. 30 seconds) stored in the storage **102** in advance (Step S**11**), and then the processing from Step S**08** is repeated. For example, when the predefined maximum value of the remaining time is 30 seconds and 10 seconds has elapsed since the user released the PTT button **201**, the remaining time is 20 seconds. If the user touches the PTT button **201** again, the remaining time changer **112** changes the value of the remaining time from 20 seconds to 30 seconds.

When it is determined that the PTT button **201** remains untouched (Step S**10**: NO), the controller **101** determines whether the updated value of the remaining time is zero or not (Step S**12**). Note that whether or not the PTT button **201** remains untouched is determined based on whether the coordinate values of the contact point on the touchpad **121** detected every unit of time (e.g. every 25 msec.) remain out of the display range of the PTT button **201** after the contact detector **109** determines in Step S**06** that the PTT button **201** is not being touched. When the coordinate values of the contact point on the touchpad **121** remains out of the display range of the PTT button **201**, it is determined that the PTT button **201** remains untouched, and when the coordinate values are within the display range of the PTT button **201**, it is determined that the PTT button **201** has been touched again.

When the value of the remaining time is not zero (Step S**12**: YES), the processing from Step S**08** is repeated, and the timer **111** continuously updates the value of the remaining time over time.

When the remaining time runs out (Step S**12**: NO), the controller **101** relinquishes the right to speak, and brings the mobile terminal **10** into the standby mode. The communicator **107** then transmits information indicating the relinquishment of the right to speak, to the PTT management server **20** via the antenna **108** (Step S**13**).

The following describes operations of the PTT management server **20** when receiving the information indicating the relinquishment of the right to speak.

FIG. **5** is a flowchart illustrating processing performed by the PTT management server **20** when receiving the information indicating the relinquishment of the right to speak.

In the following, suppose that the mobile terminals **10***a* through **10***d* are in the same call group participating in PTT session, and the mobile terminal **10***a* has transmitted the information indicating the relinquishment of the right to speak to the PTT management server **20** in Step S**13** shown in FIG. **4**.

When receiving the information indicating the relinquishment of the right to speak from the mobile terminal **10***a* (Step S**21**: YES), the PTT management server **20** transmits information indicating that the mobile terminal **10***a* has relinquished the right to speak to the mobile terminals **10***b* through **10***d* participating in the PTT session (Step S**22**). In response to the processing in Step S**22**, the information indicating the relinquishment of the right to speak is displayed on the mobile terminals **10***b* through **10***d*. The information indicating the relinquishment of the right to speak is displayed on the mobile terminal **10***a* as well. Therefore, the users of the mobile terminal **10***a* and the mobile terminals **10***b* through **10***d* can recognize that they can acquire the right to speak. The users can acquire the right to speak in the same manner as the mobile terminal **10***a* and then speak.

Next, referring to FIG. **6**, the following explains operations for changing the remaining time by operating the display position of the indicator **203** under the condition that the PTT button **201** has been released after the acquisition of the right to speak, but the right to speak has not been relinquished yet.

FIG. **6** is a flowchart illustrating processing performed by the mobile terminal **10** when the user performs a drag operation on the indicator **230** to change the remaining time.

First, the contact detector **109** detects whether the indicator **203** displayed on the display **106** is being touched or not (Step S**31**). Specifically, the contact detector **109** determines that the indicator **203** is being touched when the coordinate values

of the contact point on the touchpad **121**, which are detected every unit time (e.g. every 25 msec.), are within the display range of the indicator **203**.

When contact with the indicator **203** is detected (Step S**31**: YES), the display position changer **110** determines whether the display position of the indicator **203** has been changed to a holding position **204** by a user operation (Step S**32**). Specifically, the display position changer **110** determines whether the indicator **203** has been dragged to the range of the holding position **204** based on the coordinate values of the contact point received from the controller **101**. When the position of the indicator **203** is within the range of the holding position **204**, the display position changer **110** determines that the display position of the indicator **203** has been moved to the holding position **204**.

When it is determined that the display position of the indicator **203** has been moved to the holding position **204** (Step S**32**: YES), the remaining time changer **112** changes the value of the remaining time to the value stored in the storage **102** in advance (e.g. 30 seconds) (Step S**35**), and the timer **111** suspends updating the value of the remaining time (Step S**36**).

When the contact detector **109** detects a contact with the indicator **203** under such a condition (Step S**37**: YES), the display position changer **110** determines whether the indicator **203** has been moved onto the time bar **202** by a user operation (Step S**38**). Specifically, when determining that the indicator **203** has been moved into the display range of the time bar **202** by a drag operation based on the coordinate values of the contact point on the touchpad **121** continuously received from the controller **101** every unit time, the contact detector **109** determines that the indicator **203** has been moved onto the time bar **202**.

The remaining time changer **112** calculates the value of the remaining time corresponding to the display position of the indicator **203** on the time bar **202**. The remaining time changer **112** then changes the value of the remaining time to the value so calculated, and sends the value of the remaining time after change to the timer **111**. Time T corresponding to the display position of the indicator **203** is calculated by, for example, $T=T0\times L/L0$, where L**0** denotes the length of the time bar, T**0** denotes the maximum value of the remaining time, and L denotes the length between the bottom end of the time bar **202** and the indicator **203**.

The timer **111** receives the value of the remaining time from the remaining time changer **112**, and resumes updating the value of the remaining time (Step S**39**).

On the other hand, in the case of NO in Step S**32**, the contact detector **109** determines whether the display position of the indicator **203** on the time bar **202** has been changed, and when determining that the display position of the indicator **203** has been changed, the contact detector **109** sends the coordinate values to the display position changer **110** (Step S**33**). Specifically, the contact detector **109** obtains the coordinate values of the indicator **203** after the drag operation based on the coordinate values of the contact point on the touchpad **121** detected every unit time (e.g. every 25 msec.).

When it is determined that the display position of the indicator **203** on the time bar **202** has been changed (Step S**33**: YES), the remaining time changer **112** calculates the remaining time corresponding to the display position of the indicator **203** on the time bar **202**, and changes the value of the remaining time to the value thus calculated (Step S**34**). The calculation of the remaining time corresponding to the display position is performed in the same manner as already explained above as to Step S**38**.

In the case of NO in Step S**33**, the processing is terminated.

1-4. Supplemental Descriptions

(PTT Call System **1**)

The following describes operations of the PTT call system **1** during a call, with reference to FIG. **7**.

FIG. **7** shows an example of a processing sequence of the PTT call system **1** during a call.

First, to make a one-to-many group call, the mobile terminal **10***a* requests the PTT management server **20** to establish a PTT session, appointing the mobile terminals **10***b*, **10***c* and **10***d* (Step S**100**).

Upon receipt of the request, the PTT management server **20** requests each of the mobile terminals **10***b* through **10***d* to participate in the PTT session requested by the mobile terminal **10***a* (Steps S**101***b*, S**101***c*, S**101***d*).

Upon receipt of the request for participation, each of the mobile terminals **10***b* through **10***d* transmits information indicating acceptance of the request to participate in the PTT session to the PTT management server **20** (Steps S**102***b*, S**102***c*, S**102***d*). When there is no response from a mobile terminal or there is a response indicating denial of participation in the PTT session from a mobile terminal, the PTT management server **20** does not invite such a mobile terminal to the PTT session.

Upon receipt of the information indicating acceptance of the request to participate in the PTT session, the PTT management server **20** transmits a notification of establishment of the PTT session to the mobile terminals **10***a* through **10***d* (Steps S**103***a*, S**103***b*, S**103***c*, S**103***d*). Note that the PTT management server **20** establishes the PTT session when any one of the mobile terminals accepts the request to participate in the PTT session, and the PTT management server **20** does not transmit the notification of establishment of the PTT session to the mobile terminals that did not respond to the request or did not accept the request.

After establishment of the PTT session, any one of the mobile terminals **10***a* through **10***d* can speak upon acquiring the right to speak while none of the other mobile terminals participating in the PTT session is holding the right to speak.

Completion of Step S**103***a* through Step S**103***d* results in establishment of the PTT session involving the mobile terminals **10***a* through **10***d* as a call group. At this point, none of the mobile terminals is holding the right to speak.

First, the mobile terminal **10***a* transmits a request for the right to speak to the PTT management server **20** in order to be allowed to transmit a voice (Step S**104**).

Upon receipt of the request for the right to speak from the mobile terminal **10***a*, the PTT management server **20** confirms that none of the mobile terminals **10***b* through **10***d* is holding the right to speak, then accepts the request for the right to speak and transmits a notification of the acceptance to the mobile terminal **10***a* (Step S**105**).

Furthermore, the PTT management server **20** transmits, to the mobile terminals **10***b* through **10***d*, a notification indicating that the mobile terminal **10***a* has acquired the right to speak (Steps S**106***b*, S**106***c*, S**106***d*). The mobile terminal **10***a* can transmit a voice to each of the mobile terminals **10***b* through **10***d* during a period until relinquishment of the right to speak, during which each of the mobile terminals **10***b* through **10***d* receives a voice from the mobile terminal **10***a*.

When finishing speaking and relinquishing the right to speak, the mobile terminal **10***a* transmits information indicating relinquishment of the right to speak to the PTT manage-

ment server **20** (Step S**107**). Upon receipt of the information indicating relinquishment of the right to speak from the mobile terminal **10***a*, the PTT management server **20** transmits, to the mobile terminals **10***b* through **10***d*, a notification indicating that the mobile terminal **10***a* has relinquished the right to speak (Steps S**108***b*, S**108***c*, S**108***d*). Through these operations, any one of the mobile terminals **10***a* through **10***d* participating in the PTT session can acquire the right to speak next time.

In the example shown in FIG. **7**, it is the mobile terminal **10***c* that subsequently transmits a request for the right to speak to the PTT management server **20** (Step S**109**). Upon receipt of the request for the right to speak from the mobile terminal **10***c*, the PTT management server **20** confirms that none of the mobile terminals **10***a*, **10***b* and **10***d* is holding the right to speak, then accepts the request for the right to speak received from the mobile terminal **10***c*, and transmits a notification of the acceptance to the mobile terminal **10***c* (Step S**110**).

Furthermore, the PTT management server **20** transmits, to the mobile terminals **10***a*, **10***b* and **10***d*, a notification indicating that the mobile terminal **10***c* has acquired the right to speak (Steps S**111***a*, S**111***b*, S**106***d*).

The mobile terminal **10***c* can transmits a voice during a period until relinquishment of the right to speak, during which each of the mobile terminals **10***b* through **10***d* receives a voice from the mobile terminal **10***a*.

When finishing speaking and relinquishing the right to speak, the mobile terminal **10***c* performs the same processing as in Step S**107**, and the PTT management server **20** transmits, to the mobile terminals **10***a*, **10***b* and **10***d*, a notification indicating the relinquishment of the right to speak. Processing performed when the mobile terminal **10***b* or **10***d* transmits a voice is the same as the processing performed when the mobile terminal **10***a* transmits a voice. As described above, each of the mobile terminals participating in a PTT session requests for the right to speak before every speech, and transmits a voice after acquiring the right to speak.

Next, processing performed for terminating a PTT session is described below.

A PTT session is terminated by a request for terminating the PTT session made by the mobile terminal **10***a* that made the request for establishment of the PTT session. The mobile terminal **10***a* transmits a request for terminating the PTT session to the PTT management server **20** (Step S**112**). Upon receipt of the request for terminating the PTT session from the mobile terminal **10***a*, the PTT management server **20** transmits a notification of the termination of the PTT session to the mobile terminals **10***a* through **10***d*, and the mobile terminals **10***a* through **10***d* terminates the communication with the PTT management server **20** (Steps S**113***a*, S**113***b*, S**113***c*, S**113***d*). Consequently, the PTT session among the mobile terminals **10***a* through **10***d* is terminated.

1-5. Examples of User Operations

The following describes user operations of the mobile terminal **10** having the above-described configuration, with reference to FIG. **8**.

FIG. **8**A illustrates the indicator **203** when the user touches the PTT button **201** to acquire the right to speak. FIG. **8**B illustrates the display position of the indicator **203** when the user, after acquiring the right to speak, releases the PTT button **201**, and the remaining time is approximately the half of the predefined maximum time.

When the user touches the PTT button **201** with a finger for example, the indicator **203** is displayed at the top end of the time bar **202**. The countdown of the remaining time is suspended while the user is touching the PTT button **201**, and the indicator **203** stays at the top end of the time bar **202** as illustrated in FIG. **8**A.

When the user releases the PTT button **201**, the countdown of the remaining time resumes, and accordingly the indicator **203** gradually moves along the time bar **202** over time, as illustrated in FIG. **8**B. When the remaining time becomes zero, the indicator **203** is displayed at the bottom end of the time bar **202**, and the mobile terminal **10** transmits a notification of the relinquishment of the right to speak to the PTT management server **20**. If the user again touches the PTT button **201** before the indicator **203** is displayed at the bottom end of the time bar **202**, the remaining time is extended, and the indicator **203** is displayed at the top end of the time bar **202** as illustrated in FIG. **8**A.

In this way, with the mobile terminal **10** pertaining to the present embodiment, the user can visually check the remaining time to the relinquishment of the right to speak by seeing the indicator **203** displayed on the display **106**. Also, the user can extend the remaining time to the relinquishment of the right to speak by touching the PTT button **201**.

FIG. **8**C illustrates that the display position of the indicator **203** has been changed to the holding position **204**. As illustrated in the figure, when the indicator **203** is displayed at the holding position **204**, the countdown of the remaining time is suspended, and the state of the mobile terminal **10** is maintained the same as when the PTT button **201** is being touched. In the situation illustrated in FIG. **8**B, the value of the remaining time can be changed by moving the display position of the indicator **203** upwards or downwards along the time bar **202**. The remaining time is increased when the display position of the indicator **203** is moved upwards, and is reduced when the display position of the indicator **203** is moved downwards. The remaining time is zero when the time bar **202** reaches the bottom end. At this point, the mobile terminal **10** transmits a notification of the relinquishment of the right to speak to the PTT management server **20**.

In this way, the user can increase or reduce the remaining time to the relinquishment of the right to speak by changing the display position of the indicator **203** showing the remaining time. Furthermore, the user can maintain the state of the mobile terminal **10** when the PTT button **201** is being touched without keeping touching the PTT button **201**, by fixing the display position of the indicator **203** at a predefined display position.

When the indicator **203** is moved to the holding position **204**, the mobile terminal **10** transmits a notification to the PTT management server **20**, and accordingly the other mobile terminals participating in the PTT session via the PTT management server **20**, or possibly all the mobile terminals participating in the PTT session including the mobile terminal **10**, are notified of the movement. Alternatively, the other mobile terminals participating in the PTT session via the PTT management server **20**, or possibly all the mobile terminals participating in the PTT session including the mobile terminal **10**, are notified of the movement at predefined intervals. Thus, when the indicator **203** of a mobile terminal is moved to the holding position **204**, the users of the other mobile terminals participating in the PTT session are notified of the movement. Furthermore, when the notification of the movement of the indicator **203** to the holding position **204** is made at predefined intervals, the user of the mobile terminal holding the right to speak is reminded not to forget relinquishing the right to speak.

Embodiment 2

2-1. Overview

In Embodiment 2, a mobile terminal in a PTT call system having a function of terminating a PTT session when the situation continues for a predefined period where none of the mobile terminals **10***a* through **10***d* participating in the PTT session has the right to speak.

Note that explanation of the same features as in Embodiment 1 is omitted, and differences are mainly explained below.

2-2. Configuration

Regarding the mobile terminal pertaining to the present embodiment, explanation of the same components as the mobile terminal **10** pertaining to Embodiment 1 is omitted, and differences are mainly explained below. Note that the reference numbers for the mobile terminal pertaining to the present embodiment are the same as in Embodiment 1.

The present embodiment is different from Embodiment 1 in that the controller **101** of the mobile terminal **10** provides an instruction to terminate the PTT session when the remaining time becomes zero, instead of relinquishing the right to speak. Note that unlike in Embodiment 1, the expression "remaining time" used in the present embodiment is the time from when the user stops touching the PTT button **201** to when the PTT session is to be terminated.

The storage **102** stores, instead of the predefined maximum time of a speech to be provided when the right to speak is obtained once, a value of maximum time (e.g. 5 minutes) to the disconnection of the PTT session that occurs when the situation continues for a predefined period where none of the mobile terminals participating in the PTT session has the right to speak.

Note that in the mobile terminal pertaining to the present embodiment, the indicator **203** is used for displaying the remaining time to the disconnection of a PTT session, and the indicator **203** does not accept a drag operation, unlike in Embodiment 1.

2-3. Operations

Next, the following describes operations of the mobile terminal **10** having the above-described configuration.

FIG. **9** a flowchart illustrating processing for controlling the remaining time to the termination of a PTT session of the mobile terminal **10**.

First, the mobile terminal **10** connects to the PTT management server **20**, and establishes a PTT session (Step S**41**). Upon establishment of the PTT session, the controller **101** sets the value of the remaining time to the termination of the PTT session to be the time stored in advance in the storage **102** (e.g. 5 minutes), and transmits the value to the timer **111** (Step S**42**).

The display position changer **110** calculates the coordinate values of the display position of the indicator **203** on the time bar **202** when the value of the remaining time indicates the maximum time, and sends the coordinate values to the controller **101**. The controller **101** instructs the display **106** to display the indicator **203** at the position specified by the coordinate values, and the display **106** displays the indicator **203** at the position indicated by the coordinate values (Step S**43**).

The timer **111** starts updating the value of the remaining time (Step S**44**), and continuously updates the value of the remaining time to the termination of the PTT session over time (Step S**45**).

The display position changer **110** continuously receives the value of the remaining time from the timer **111**, calculates the coordinate values used for chanting the display position of the indicator **203** on the display **116** according to the remaining time, and sends the coordinate values to the controller **101**. The controller **101** instructs the display **106** to display the indicator **203** at the position specified by the coordinate values, and the display **106** displays the indicator **203** at the position indicated by the coordinate values (Step S**46**). Note that the calculation of the display position of the indicator **203** is performed in the same manner as in Step S**09** of Embodiment 1.

Next, the controller **101** determines whether any of the mobile terminals participating in the PTT session has the right to speak (Step S**47**). Specifically, the controller **101** determines whether the PTT button **201** of the mobile terminal **10** has been touched to acquire the right to speak. When the mobile terminal **10** has the right to speak, it is determined to be "YES" in Step S**47**. When the mobile terminal **10** does not have the right to speak, the controller **101** determines whether any other mobile terminal participating in the PTT session has the right to speak. As already explained with reference to FIG. **7**, when one of the mobile terminals participating in the PTT session acquires the right to speak, a notification of the acquisition of the right to speak is transmitted by the PTT management server **20** to the other mobile terminals, and when the mobile terminal relinquishes the right to speak, a notification of the relinquishment of the right to speak is transmitted to the other mobile terminals. According to the notification of the relinquishment of the right to speak, each mobile terminal stores information indicating which mobile terminal has acquired and relinquished the right to speak at what time, and determines whether any other mobile terminal has the right to speak or not according to the stored information. When the controller **101** determines that one of the other mobile terminals has the right to speak, the result of the determination in Step S**47** will be "YES". On the other hand, when it is determined that none of the mobile terminals, including the mobile terminal **10**, does not have the right to speak, the result of the determination in Step S**47** will be "NO".

In the case of "YES" in Step S**47**, the remaining time changer **112** changes the value of the remaining time to the value stored in advance in the storage **102** (e.g. 5 minutes), and the processing from Step S**45** is repeated.

When determining that still none of the mobile terminals participating in the PTT session has the right to speak (Step S**47**: NO), the controller **101** determines whether the updated value of the remaining time is zero or not (Step S**49**). When the value of the remaining time is not zero (Step S**49**: YES), the processing from Step S**45** is repeated, and the timer **111** continuously updates the value of the remaining time over time.

When the value of the remaining time is zero (Step S**49**: NO), the controller **101** transmits information indicating the termination of the PTT session to the PTT management server **20**, and disconnects from the PTT management server **20** (Step S**50**). Upon receipt of the information indicating the termination of the PTT session from the mobile terminal **10**, the PTT management server **20** transmits the information to all the other mobile terminals participating in the PTT session. Upon receipt of the information indicating the termina-

tion of the PTT session from the PTT management server **20**, the other mobile terminals disconnect from the PTT management server **20**.

2-4. Summary

Through the operations described above, the mobile terminal **10** pertaining to the present embodiment allows for visual indication of the remaining time to the termination of the PTT session when the situation continues for a predefined period where none of the mobile terminals participating in the PTT session has the right to speak. Also, the mobile terminal **10** can extend the remaining time to the termination of the PTT session by acquiring the right to speak.

3. Modifications

Although embodiments of the mobile terminal pertaining to the present invention are described above, the mobile terminal may be modified as described below, and the present invention is not limited to the embodiments described above.

(1) The mobile terminal **10** may exchange information related to the remaining time with the PTT management server **20**, and share the information among the other mobile terminals participating in the PTT session.

FIG. **10** is a flowchart illustrating processing performed by the mobile terminal **10** when receiving information indicating the remaining time from the PTT management server **20**.

The controller **101** determines whether the communicator **107** has received information related to the remaining time (e.g. the value of the remaining time) from the PTT management server **20** via the antenna **108** (Step S**51**).

When it is determined that the communicator **107** has received the information related to the remaining time from the PTT management server **20** (Step S**51**: YES), the remaining time changer **112** changes the value of the remaining time of the mobile terminal **10** according to the information related to the remaining time, received from the PTT management server **20** (Step S**52**). Note that the information related to the remaining time is the value of the remaining time, for example. This processing is performed as interrupt processing during Step S**07** through Step S**12** in FIG. **4** and Step S**44** through S**49** in FIG. **9**, for example.

Next, the following describes the operations of the PTT management server **20** when receiving from the mobile terminal **10** the information indicating the remaining time to the termination of the PTT session.

FIG. **11** is a flowchart illustrating processing performed by the PTT management server **20** when receiving the information indicating the remaining time from the mobile terminal **10**.

When receiving the information indicating the remaining time from the mobile terminal **10** (Step S**61**: YES), the PTT management server **20** determines whether the value of the remaining time is zero or not (Step S**62**).

When the value of the remaining time is not zero (Step S**62**: YES), the PTT management server **20** transmits the information indicating the same value of the remaining time to each of the other mobile terminals participating in the PTT session (Step S**63**). On the other hand, when the value of the remaining time is zero (Step S**62**: NO), the PTT management server **20** transmits information indicating the termination of the PTT session to each of the other mobile terminals participating in the PTT session.

Through these operations, each of the mobile terminals participating in the PTT session is enabled to display the same value of the remaining time to the termination of the PTT session.

The transmission of the information indicating the remaining time from the mobile terminal **10** to the PTT management server **20** is performed when, for example, the remaining time is changed in Step S**48** in FIG. **9**. The mobile terminal **10** transmits the value of the remaining time to the PTT management server **20**. When receiving the value of the remaining time from the mobile terminal **10**, the PTT management server **20** transmits the value of the remaining time so received to the other mobile terminals participating in the PTT session. Each mobile terminal changes the display position of the indicator **203** according to the value of the remaining time received from the PTT management server **20**.

Note that the information indicating the remaining time, which is received in Step S**61**, does not necessarily indicate the remaining time to the termination of the PTT session, and may indicate the remaining time to the relinquishment of the right to speak. If this is the case, the remaining time indicated by the information transmitted in Step S**63** to each mobile terminal is the remaining time to when the mobile terminal holding the right to speak relinquishes the right to speak, and the information transmitted in Step S**64** indicates the relinquishment of the right to speak. Thus each of the mobile terminals participating in the PTT session is enabled to display the same value of the remaining time to the relinquishment of the PTT session. Therefore, the users of the mobile terminals participating in the PTT session can check the remaining time to the relinquishment of the right to speak held by another mobile terminal, and can efficiently perform an operation for acquiring the right to speak in the next turn. Note that a mobile terminal not holding the right to speak may turn off the back light **123** of the display **106** upon elapse of a predefined time since the mobile terminal relinquishes the right to speak. This reduces the amount of power consumption of the mobile terminal.

(2) In Embodiment 2, the indicator **203** does not accept a drag operation. However, modification may be adopted in order to allow the user to change the remaining time by changing the display position of the indicator **203**.

Note that the operation for changing the display position of the indicator **203** of the mobile terminal **10**, and the calculation of the remaining time according to the display position, are performed in the same manner as described with reference to FIG. **6** for Embodiment 1.

Furthermore, when the remaining time to the termination of the PTT session is changed by a drag operation on the indicator **203** of a mobile terminal, the value of the remaining time may be transmitted to the PTT management server **20** so that the PTT management server **20** and the other mobile terminals can display the same value of the remaining time.

If this is the case, the value of the remaining time is transmitted to the PTT management server **20** upon completion of Step S**34** and Step S**39** in FIG. **6**.

The value of the remaining time transmitted to the PTT management server **20** is transmitted to the other mobile terminals participating in the PTT session through the processing described in Modification (1) above. Each mobile terminal updates the remaining time to the termination of the PTT, and the display position of the indicator **203** displayed on each of the mobile terminals changes accordingly. Through these operations, when the value of the remaining time to the termination of the PTT session is updated by any one of the mobile terminals participating in the PTT session, the updated value of the remaining time is transmitted to all the mobile terminals participating in the PTT session, so that all the mobile terminals can display the same remaining time.

(3) In Embodiment 2, a PTT session is terminated when the value of the remaining time becomes zero. Alternatively,

however, modification may be adopted so that only the mobile terminal **10** exits from the PTT session. If this is the case, the mobile terminal **10** transmits, to the PTT management server **20**, information indicating that the mobile terminal **10** has exited from the PTT session, instead of the information indicating the termination of the PTT session. Upon receipt of the withdrawal from the PTT session from the mobile terminal **10**, the PTT management server **20** transmits, to the other mobile terminals participating in the PTT session, information indicating that the mobile terminal **10** has withdrawn from the PTT session. Through these operations, only the mobile terminal **10** withdraws from the PTT session, and the PTT session is maintained by the other mobile terminals.

In Embodiment 2, the request for terminating a PTT session is made from the mobile terminal that has made the request for establishing the PTT session. In this modified example, however, any of the mobile terminals participating in the PTT session can request the PTT management server **20** to terminate the PTT session.

(4) In embodiments above, the image indicating the remaining time, which is displayed on the display **106** as shown in FIG. **3**, is not necessarily exactly the same as shown in FIG. **3**. The image may be configured in any manner insofar as it allows for an operation for changing the remaining time.

For example, the image may be configured as shown in FIGS. **12**A through **12**C.

In FIG. **12**A, the remaining time is expressed by an indicator **203***b* going down the slope of the time bar **202***b* over time. The indicator **203***b* located at the bottom end of the slope shows that the remaining time is zero. FIG. **12**B shows that the indicator **203***b* returns to the top end of the slope and the remaining time is extended when the PTT button **201** is touched under the situation shown in FIG. **12**A.

FIG. **12**C shows a situation where the display position of the indicator **203***b* has been changed to a holding position **204***b*. In this situation, the remaining time is not counted down, and the indicator **203***b* is maintained at the holding position **204***b*.

Furthermore, a relinquishment button **205** for relinquishing the right to speak may be provided as shown in FIG. **12**, and when the relinquishment button **205** is touched, the remaining time may be set to zero and the right to speak may be relinquished immediately.

(5) The display position of the indicator **203** is not necessarily proportional to the remaining time insofar as the user can know the remaining time. For example, the time bar **202** may be configured such that the period from the predefined maximum remaining time to the midpoint corresponds to a fourth of the length of the time bar **202**, and the period from the midpoint to zero corresponds to three-fourths of the length of the time bar **202** so that the elapse of time during this period can be displayed in further detail. If this is the case, when L**0** denotes the length of the time bar **202**, T**0** denotes the predefined maximum value of the remaining time, and T denotes the remaining time, the distance L of the indicator **203** from the bottom end of the time bar **202** is represented by $L=(1-T/T0)\times L0/2$ when $T>T0/2$, and $L=(3T/2T0)\times L0$ when $T\leq T0/2$.

Thus, the elapse of the remaining time in further detail can be presented to the user when the remaining time is running out.

(6) In Embodiment 1, when the display position of the indicator **203** indicating the remaining time of the right to speak is changed to the holding position **204**, the remaining time is not counted down, the mobile terminal **10** remains in the same state as when the PTT button **201** is being touched. Here, the right to speak may be automatically relinquished when a predefined period (e.g. 60 seconds) has elapsed under this situation without the user's speech. The determination as to whether the user is speaking or not can be made based on the level of audio input to the microphone. Specifically, it is determined that the user is speaking when the level of audio input to the microphone is higher than a predefined level, and otherwise, it is determined that the user is not speaking.

This configuration prevents a problem that the user does nothing for a long time despite having the right to speak and the other participants cannot acquire the right to speak.

(7) In Embodiment 1, the remaining time is extended to the maximum time stored in advance in the storage **102** when the PTT button **201** is touched. However, the remaining time may be extended by predefined time each time the PTT button **201** is touched. For example, the time by which the remaining time is extended when the PTT button is touched once may be set to be shorter than the maximum time (e.g. 5 seconds), which allows for more flexible control of the remaining time.

(8) The mobile terminal **10** may further include a proximity sensor (not illustrated) that detects whether an object is in the proximity to the sensor, and a hardware button used for PTT calls (not illustrated. hereinafter referred to as "PTT hard button"). The proximity sensor is, for example, an infrared sensor, which detects an object in the proximity to the sensor by transmitting infrared light and receiving reflection light from an object. When the proximity sensor detects an approaching object during a PTT session, the controller **101** invalidates or does not accept input from the touchpad **121**, and accept input from the hardware button for PTT calls. When the proximity sensor does not detects an approaching object, the controller **101** validates or accepts input from the touchpad **101**, and invalidates operations on the hardware button for PTT calls. This configuration improves, for example, operability when the user uses the mobile terminal **10** in the same manner as common mobile telephones, by placing the speaker **104** on the ear. Note that the proximity sensor may be located adjacent to the speaker of the mobile terminal **10**. Note that the object mentioned above is an object that reflects infrared light, such as the user's face.

FIG. **13** is a flowchart illustrating processing of switching between an operation with the PTT button **201** and an operation with the hardware button for PTT calls.

The controller **101** determines whether a PTT session has been started or not (Step S**71**). Specifically, the controller **101** of the mobile terminal **10** requests the PTT management server **20** to establish a PTT session, and determines that a PTT session has been started when receiving a notification of establishment of a PTT session from the PTT management server **20**, or when another terminal makes a request for participation in the PTT session via the PTT management server **20** and the PTT management server **20** accepts the request.

When it is determined that the PTT session has been started (Step S**71**: YES), the proximity sensor determines whether the user's face, for example, is approaching the proximity sensor. When the proximity sensor determines that the object such as the user's face is approaching the proximity sensor (Step S**72**: YES), the controller **101** disables the touchpad **121** from receiving input thereto (Step S**73**), and enables the PTT hard button to receive input thereto (Step S**74**). On the other hand, in the case of NO in Step S**72**, i.e., when the proximity sensor detects that an object such at the user's face is not approaching the proximity sensor, the controller **101** disables the PTT hard button from receiving input thereto (Step S**75**), and enables the touchpad **121** to receive input thereto (Step S**76**).

Next, the controller **101** determines whether the PTT session has been terminated (Step S**77**). Specifically, the controller **101** makes the determination as to termination of the PTT session by determining whether the mobile terminal **10** has requested the PTT management server **20** to terminate the PTT session, and whether the mobile terminal **10** has received the notification of the termination of the PTT session from the PTT management server **20**.

When it is determined that the PTT session has not been terminated (Step S**77**: NO), the controller **101** repeats processing from Step S**72**, and enables the PTT button **201** displayed on the touchpad or the PTT hard button in order to accept the above-described PTT button operation according to the way of the use of the mobile terminal **10**.

When it is determined that the PTT session has been terminated (Step S**77**: YES), the controller **101** enables the PTT hard button to receive input thereto (Step S**78**), and enables the touchpad **121** to receive input thereto (Step S**79**).

As described above, when the user uses the mobile terminal **10** while seeing the display **106**, the user can operate the touchpad **121**, and when the user uses the mobile terminal **10** in the same manner as common mobile phones by placing the speaker on the ear, the user can operate the PTT hard button in a conventional manner, instead of the touchpad **121**.

(9) In the embodiments above, the functions of the controller of the mobile terminal are realized by a computer program. However, all or some of the functions performed by the controller may be realized with a single-chip or multiple-chip integrated circuit or any others.

(10) Among the constituent elements described in the embodiments, the controller, the contact detector, the display position changer, the timer, the remaining time changer and the communicator may be realized with a single-chip or multiple-chip integrated circuit, computer programs, or any others. These constituent elements cooperate with the processor of the mobile terminal to realize the respective functions.

The programs may be recorded on a recording medium or distributed via various communication channels. Examples of such a recording medium includes an IC card, a hard disk, an optical disc, a flexible disk, ROM, a flash memory, and so on.

The distributed programs are stored in a memory or the like that is readable by a processor of the mobile terminal, and the functions of the mobile terminal described in embodiments above are realized by the processor executing the programs.

(11) The above-described embodiments and modifications may be partially combined.

4. Supplemental Descriptions

The following further explains the configuration of the mobile terminal pertaining to one aspect of the present invention, modifications applicable to the mobile terminal, and advantageous effects of the mobile terminal.

(1) A mobile terminal pertaining to an embodiment of the present invention is a mobile terminal having a push-to-talk (PTT) function, comprising: a controller that, upon detection of an operation for terminating a predefined call mode, maintains the predefined call mode for a period of predefined time, and terminates the predefined call mode upon elapse of the period; a display that displays remaining time to termination of the predefined call mode; and a remaining time changer that, upon detection of an operation for changing the remaining time, changes the remaining time according to the operation for changing the remaining time.

This mobile terminal maintains the predefined call mode for a predefined period even when an operation for terminating the predefined call mode is detected, and displays the remaining time to the termination of the mode. Furthermore, the user can change the remaining time by a predefined operation. Therefore, even when the user mistakenly releases the PTT button, the mobile terminal can maintain the mode for acquiring the right to speak and making a call, and can maintain the PTT session, thereby preventing unintended disconnection of a call or a PTT session.

(2) The display may include a touch panel, and displays, on the touch panel, a button used for acquiring a right to speak in PTT, the mobile terminal further comprises a contact detector that detects contact with the touch panel, and the remaining time changer changes the remaining time when the contact detector detects contact with the button.

With this mobile terminal, when the button displayed on the touch panel, used for acquiring the right to speak, is touched, the remaining time to the predefined call mode is changed to a predefined time.

Therefore, when the remaining time is running out, the user can extend the remaining time to the redefined time by touching the button.

(3) The mobile terminal may further comprise a timer that starts updating the remaining time when contact with the button detected by the contact detector is lost.

With this mobile terminal, the countdown of the remaining time is started after the user touches the button displayed on the touch panel and stops touching the button, i.e., when the user releases the PTT button.

(4) The touch panel may display an image indicating the remaining time at a display position on a predefined path, the display position corresponding to the remaining time, the mobile terminal may further comprise a display position changer that changes the display position of the image on the predefined path in response to an operation for moving the image along the predefined path, and the remaining time changer may change the remaining time according to the display position so changed.

With this mobile terminal, the user can change the remaining time to the termination of the predefined call mode by changing the display position of the image representing the remaining time. The remaining time changes according to the display position of the image.

Therefore, the user can control the remaining time to the relinquishment of the right to speak or the remaining time to the termination of the PTT session by a simple operation.

(5) The display position changer, upon a user operation of dragging the image to a predefined position that is out of the predefined path, may change the display position of the image to the predefined position, the remaining time changer, when the display position of the image is moved to the predefined position, may change the remaining time to the predefined time, and the timer may suspend updating the remaining time until the display position of the image is moved back to the predefined path by a user operation.

With this mobile terminal, when an operation is made to move the image representing the remaining time to a predefined display position that is out of a predefined path for representing the remaining time, the image representing the remaining time is moved to the predefined display position, the remaining time is changed to a predefined time, and the countdown of the remaining time is thereby suspended.

Therefore, even when the user releases the PTT button, the mobile terminal is maintained in the same state as when the PTT button is being touched.

(6) The predefined call mode may be a mode of holding a right to speak in PTT, and the controller may relinquish the right to speak when the remaining time is zero.

This mobile terminal displays the remaining time to the relinquishment of the right to speak, and relinquishes the right to speak when the remaining time becomes zero.

Therefore, the user can know the remaining time to the relinquishment of the right to speak while not touching the PTT button.

(7) The predefined call mode may be a mode of establishing a PTT session, and the controller may terminate the PTT session when the remaining time is zero.

This mobile terminal displays the remaining time to termination of the PTT session, and terminates the PTT session when the remaining time becomes zero.

Therefore, when releasing the PTT button, the user can know the remaining time to the termination of the PTT session.

(8) The mobile terminal may further comprise a communicator that exchanges information related to the remaining time with an external PTT management server, and when the communicator receives the information from the external PTT management server, the remaining time changer may change the remaining time according to the information received from the external PTT management server.

This mobile terminal can change the remaining time thereof based on information related to the remaining time, received from the external PTT management server.

Therefore, the same remaining time can be set to the PTT management server and all the mobile terminals participating in the PTT session.

(9) When the remaining time changer changes the remaining time according to the operation for changing the remaining time, the communicator may transmit to the external PTT management server the information related to the remaining time so changed.

This mobile terminal can transmit information related to the remaining time held thereby to the external PTT management server when the remaining time is changed by a user operation. The PTT management server can transmit the remaining time to the other mobile terminals, and therefore the same remaining time can be set to the PTT management server and all the mobile terminal participating in the PTT session.

(10) The mobile terminal may further comprise: a proximity sensor that detects an approaching object; a hardware button that is used for acquiring a right to speak in PTT; and an input controller that disables the touch panel from receiving input thereto and enables the hardware button to receive input thereto when the proximity sensor detects an approaching object, and enables the touch panel to receive input thereto and disables the hardware button from receiving input thereto while the proximity sensor is not detecting an approaching object.

This mobile terminal, when the proximity sensor detects that the user's face, for example, is approaching the mobile terminal, enables the hardware button to accept an operation for acquiring the right to speak in a PTT call and disables the touch panel.

Therefore, the user can use the mobile terminal while operating the hardware button, in the same manner as common mobile phones.

(11) A mobile terminal control method pertaining to an embodiment of the present invention is a method for controlling a mobile terminal having a push-to-talk (PTT) function, comprising: maintaining, upon detection of an operation for terminating a predefined call mode, the predefined call mode for a period of predefined time, and terminating the predefined call mode upon elapse of the period; displaying remaining time to termination of the predefined call mode; and changing, upon detection of an operation for changing the remaining time, the remaining time according to the operation for changing the remaining time.

The method having the stated configuration for controlling a mobile terminal maintains the predefined call mode for a predefined period even when an operation for terminating the predefined call mode is detected, and displays the remaining time to the termination of the mode. Furthermore, the user can change the remaining time by a predefined operation.

Therefore, even when the user mistakenly releases the PTT button, the mobile terminal can be controlled in order to prevent sudden disconnection of a call during a speech.

(12) A mobile terminal control program pertaining to an embodiment of the present invention is a control program for controlling a mobile terminal having a push-to-talk (PTT) function, the control program causing the mobile terminal to perform the steps of: maintaining, upon detection of an operation for terminating a predefined call mode, the predefined call mode for a period of predefined time, and terminating the predefined call mode upon elapse of the period; displaying remaining time to termination of the predefined call mode; and changing, upon detection of an operation for changing the remaining time, the remaining time according to the operation for changing the remaining time.

The program having the stated configuration for controlling a mobile terminal maintains the predefined call mode for a predefined period even when an operation for terminating the predefined call mode is detected, and displays the remaining time to the termination of the mode. Furthermore, the user can change the remaining time by a predefined operation.

Therefore, even when the user mistakenly releases the PTT button, the mobile terminal can be controlled in order to prevent sudden disconnection of a call during a speech.

INDUSTRIAL APPLICABILITY

The mobile terminal pertaining to one aspect of the present invention can be used for realizing one-to-many group calls.

REFERENCE SIGNS LIST

1. PTT call system
20 PTT management server
21 communication network
10, **10***a*, **10***b*, **10***c*, **10***d* mobile terminal
101 controller
102 storage
103 I/O
104 speaker
105 microphone
106 display
107 communicator
108 antenna
109 contact detector
110 display position changer
111 timer
112 remaining time changer
201 PTT button
202, **202***b* time bar
203, **203***b* indicator
204, **204***b* holding position
205 relinquishment button

The invention claimed is:

1. A mobile terminal comprising a push-to-talk (PTT) function, comprising:

a controller configured to, when a first operation for terminating a predefined mode of PTT is detected, maintain

the predefined mode for a period of predefined time, and terminates the predefined mode upon elapse of the period;

a display configured to display remaining time to termination of the predefined mode during the predefined mode; and

a remaining time changer configured to, when a second operation for changing the remaining time during the predefined mode is detected, change the remaining time according to the second operation.

2. The mobile terminal of claim **1**, wherein

the display comprises a touch panel, and displays, on the touch panel, a button used for acquiring a right to speak in PTT,

the mobile terminal further comprises a contact detector, wherein the contact detector is configured to detect contact with the button, and

the remaining time changer changes the remaining time when the contact detector detects the contact.

3. The mobile terminal of claim **2**, further comprising

a timer configured to start updating the remaining time when the contact is lost.

4. The mobile terminal of claim **3**, wherein

the touch panel displays an indicator at a display position on a predefined path, the display position being determined by the remaining time,

the mobile terminal further comprises a display position changer that changes the display position of the indicator on the predefined path in response to an operation for moving the indicator along the predefined path, and

the remaining time changer changes the remaining time according to the display position so changed.

5. The mobile terminal of claim **4**, wherein

the display position changer, upon detection of a user operation of dragging the indicator to a predefined position that is out of the predefined path, changes the display position of the indicator to the predefined position that is out of the predefined path,

the remaining time changer, when the display position of the indicator is changed to the predefined position, changes the remaining time to the predefined time, and

the timer suspends updating the remaining time until detection of a user operation of dragging the indicator back to the predefined path.

6. The mobile terminal of claim **5**, wherein

the predefined mode comprises a mode of holding a right to speak in PTT, and

the controller relinquishes the right to speak when the remaining time is zero.

7. The mobile terminal of claim **5**, wherein

the predefined mode comprises a mode of establishing a PTT session, and

the controller terminates the PTT session when the remaining time is zero.

8. The mobile terminal of claim **6**, further comprising

a communicator configured to receive information related to the remaining time from an external PTT management server, wherein

when the communicator receives the information, the remaining time changer changes the remaining time according to the information.

9. The mobile terminal of claim **7**, further comprising

a communicator configured to receive information related to the remaining time from an external PTT management server, wherein

when the communicator receives the information the remaining time changer changes the remaining time according to the information.

10. The mobile terminal of claim **8**, wherein

when the remaining time changer changes the remaining time according to the second operation, the communicator transmits to the external PTT management server information related to the remaining time so changed.

11. The mobile terminal of claim **9**, wherein

when the remaining time changer changes the remaining time according to the second operation, the communicator transmits to the external PTT management server information related to the remaining time so changed.

12. The mobile terminal of claim **6**, further comprising:

a proximity sensor configured to detect an approaching object;

a hardware button that is used for acquiring a right to speak in PTT; and

an input controller configured to disable the touch panel from receiving input thereto and enable the hardware button to receive input thereto when the proximity sensor detects an approaching object, and enable the touch panel to receive input thereto and disable the hardware button from receiving input thereto while the proximity sensor is not detecting an approaching object.

13. A method for controlling a mobile terminal comprising a push-to-talk (PTT) function, comprising:

maintaining, when a first operation for terminating a predefined mode of PTT is detected, the predefined mode for a period of predefined time, and terminating the predefined mode upon elapse of the period;

displaying remaining time to termination of the predefined mode during the predefined mode; and

changing, when a second operation for changing the remaining time during the predefined mode is detected, the remaining time according to the second operation.

14. A non-transitory computer readable recording medium having recorded thereon a control program for controlling a mobile terminal comprising a push-to-talk (PTT) function, the control program causing the mobile terminal to perform the steps of:

maintaining, when a first operation for terminating a predefined mode of PTT is detected, the predefined mode for a period of predefined time, and terminating the predefined mode upon elapse of the period;

displaying remaining time to termination of the predefined mode during the predefined mode; and

changing, when a second operation for changing the remaining time during the predefined mode is detected, the remaining time according to the second operation.

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